ARCHIVES

OF

USEFUL KNOWLEDGE.

VOL. II. JULY, 1811. No. 1.

STOVE FOR WARMING LARGE APARTMENTS.

The following description of an economical mode of warming large apartments, by means of heated air, is taken from the *Edinburgh Medical and Surgical Journal*, vol. 4. It is in operation at the public Hospital of the town of Nottingham in England, and in the large manufactories of Nottinghamshire, and Derbyshire, and is so obviously preferable to the mode of warming rooms by means of close iron stoves, that it ought to be adopted wherever pure warm air, regularity of temperature, or economy, are desirable. *Editor.*

THESE stoves were first constructed in the year 1792, in consequence of the inconvenience experienced by the then existing modes of warming the large rooms in which manufactures are carried on. The open fires consumed a large quantity of coal,* without materially heating the room; the people were therefore obliged to waste much time in warming themselves, and their health could not but be injured more or less by the alternate heats and chills which they were thus obliged to experience.

"The close iron stoves, so generally used, had not this inconvenience, but were, perhaps, worse upon the whole, being dusty and dangerous, and, by being heated red-hot, which they were constantly subject to be, contributed to render the air unwhole-

* Nine tons.

some and offensive, by the calcination of the iron, as well as by the burning of the various substances which are constantly floating in the air of a room.

"To introduce a large quantity of the purest air which could be procured externally, with simplicity, and to transmit the greater part of the heat generated, whatever that may be, through the stove, and to unite it with this air, were the leading objects of the improvement.

"In the common stoves, the combination of the heat that is generated with the external air is effected very imperfectly; for the air being a very bad conductor of heat, and being also transparent, is incapable of having heat communicated to it by radiation; whence it follows, that the particles of air only, which are in absolute contact with the stove, are heated by it,—then ascending, in consequence of the decrease of their specific gravity, are replaced by others; but this is performed so slowly, that the stove is covered as it were by a blanket, and very easily becomes red-hot. It was therefore conceived, that if the ascending heated air was inclosed in a tunnel of considerable perpendicular height, and that if all the air which would in consequence of the ascending force of the column, tend to rush in at the bottom, was made to impinge upon all sides of the stove, it would cool the stove, by causing a much larger quantity to come in contact with it, be itself heated of course, and thus produce a very considerable rapid current of air.

"The experiment being first tried as above, in a building containing about 200,000 cubic feet of space, and containing a great number of windows, was found to answer completely; but the stove being made of cast iron, wrought iron plate was substituted in subsequent experiments, as being, for many reasons, much more eligible. In some recent experiments, the sides of the stove, as well as the walls surrounding it, have been built perpendicular, at the distance of about seven inches; and wrought iron tubes have been inserted into each hole of the side walls, as well as in the arch over the stove, like the nozles of so many bellows, which, by causing every particle of air that is admitted, to come twice in contact with the stove, is believed to be a material improvement."

Explanation of the Plate.

A. Is a front view of the brick-work, which supports and surrounds the cockle.

a. The holes in the brick-work for the entrance of atmospherical air.

b. An iron plate acting as a damper, by partially or wholly closing the end of the horizontal chimney, which is performed by turning the handle.

c. Around the circle of which *it* forms the centre, are figures to guide the servant to the necessary degree of elevation or descension of the damper.

d. The fire-place or mouth of the cockle, which is made to slope into the brick work.

e. The pit for ashes.

f.f. Two rakes made of cast iron, and fixt in a groove in the brick-work, on each side of the grate, for cleaning the chimney flue, or to keep open a small slit made through an iron bar the whole length of the cockle, in order to form the communication betwixt the flue and the inside of the cockle.

g.g. Are two temporary bricks that shut up a space made for the reception of the soot raked from the flues.

A. 2. Shows the lower part, which has been presented in elevation.

B. Is a section of *A.*

a. The air holes.

(*d*). The grate.

h. The cockle.

j. The space between the cockle and brick-work.

k. The brick-work tunnel for the conveyance of heated air.

B. 2. Is a view of the fire-grate with the horizontal chimney.

d. The grate.

l.l.l. The chimney flues.

C. Is a transverse section of *A.*

m. The entrance to the fire-grate, or mouth of the cockle.

d. The grate.

l. The chimney.

a. The air holes.

k. The tunnel for heated air.

C. 2. Represents the passage of the smoke by the flues. The smoke rising from the fire to the top of the cockle, is forced down upon the fire, and passes off by two lateral branches, through a very narrow chink at the bottom of the cockle, into the horizontal chimney, which is carried into a vertical chimney, passing up by the side of the brick-work.

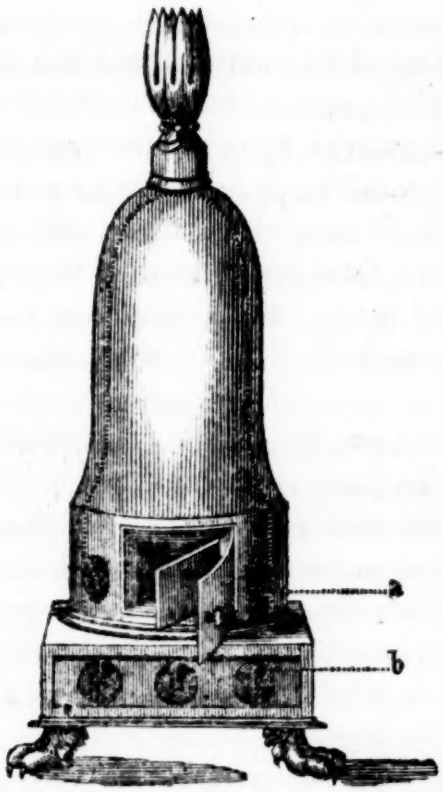
The cockle inclosed by brick-work, is placed in a small apartment, about seventeen feet below the wards to be warmed; the brick-work at the bottom is set about three inches from the cockle, but, as it is carried up perpendicular, will be five or six inches from it at the top, owing to the sides of the top of the cockle inclining inwards. The cockle is made of wrought plate iron, one-eighth of an inch in thickness, four feet square, and five feet high. The atmospheric air enters by an open window, passes through the holes in the brick-work, plays on the cockle, is heated, ascends, and, by the tunnel, is carried into a cavity, formed by making an underdrawing under the gallery of the upper rooms, leaving a space between the old ceiling and this underdrawing, two feet in depth, in the greater part seven feet broad, and 138 feet long; out of which arise tin tubes, about eight inches in diameter, proceeding into the separate apartments, two in the larger, and one in the smaller, the openings of which are closed, or partially opened by a cast iron door, with a notched latchet.

A small fire in this cockle, would, when properly managed, warm about 200,000 cubic feet of space. The head at the mouth of the tin flues should be about 120° Faren. and the air of the ward at 60°. The average quantity of coal daily consumed by the cockle, from the month of October to May, is about four cwt.; it is fed every hour, and the quantity nearly equally proportioned each time, till ten at night, when a larger quantity is required to last for the remainder of the night.

Nottingham,
August 24th, 1807.

NEW AND PORTABLE STOVE.

As the Stove, of which the cut and description follow, promises several advantages over those in common use, the Editor has pleasure in laying both before his readers.



Edinburgh, Dec. 1, 1809.

THE PATENT STOVE which is offered to the public, is so simple in its construction, that a brief description will point out the principles on which it diffuses heat, and the advantages which it has over stoves in common use.

The external appearance of it is represented in the above Figure.—It consists of two domes, one placed over the other, and distant from it, in every part, from two to three inches. The outer dome, resting on the pedestal, is represented by the outline of the figure; the inner dome is represented by the dotted line. Within this inner dome, and at the bottom of it, is a grate on which the fuel burns. The flame, the air supporting the combus-

tion, and the smoak, circulate within this inner dome, so as to heat it as equally as possible; and the smoak and current of air pass off by a tube behind, (which, from the figure being a front view, cannot be represented), this tube passing into a chimney, or being connected with a tunnel, which is led into the external air.

At the under part of the external dome, and around its circumference, are apertures, one of which is represented at *a*. Into these apertures the air enters; it rises in the space between the outer and inner domes; and being heated in its ascent, escapes warm at the upper part or neck of the dome, which is terminated by an opening, of the form represented in the figure, or of any other ornamental form. Or a tube may be adapted to this neck, and the heated air, if this is required, conveyed to a distance.

The opening at the fire-place is closed by a double door, represented in the figure, and the sides are closed by plates of iron, so that none of the smoak, or the air which has been in contact with the fuel, can escape and mingle with the current of pure air that rises between the two domes. In the pedestal is a sliding box, which serves as an ash-pit; and in the front of this, registers, marked *b*, to regulate the admission of air to the burning fuel, and of course regulate the combustion.

This is the general structure of the stove, which admits, however, of several variations, to adapt it to particular purposes, which it is not necessary to specify.

The advantages of this stove over stoves on the common construction, are, that it is free from any unpleasant smell; that it does not vitiate the air; that it diffuses the heat more equally, and therefore to greater advantage; and that, where it is required, it can be made to produce ventilation as well as warmth.

1. The unpleasant smell, and suffocating sensation produced by common stoves arise from the following cause: The stove, whatever may be its form, is, from its situation, liable to be more or less covered with dust. Whenever the fire is kindled within it, and the sides of the stove are raised nearly to a red heat, this

dust is scorched or half burnt, and produces the unpleasant smell and the suffocating feeling. Should even the stove, by uncommon care, be kept perfectly clean, still the particles of dust floating in the atmosphere are liable to be scorched by it in a similar manner, and produce to a certain extent, the same effects. This inconvenience is completely remedied in the present stove. The outer dome serves as a covering to the inner one, to prevent dust from resting upon it, and the former can never be heated to that extent to scorch any dust which may be in contact with it. The rapid current of air rising between the two domes whenever the fire is kindled, will remove any dust that might lie on the inner dome. The rapidity of this current also prevents any particles of dust diffused through the air from resting on the dome so as to be scorched; and, what is the most important effect, this current of air, constantly renewed, prevents the inner dome from being over-heated, and thus prevents the possibility of this scorching taking place. It has been supposed, that the smell from common stoves arises, in part at least, also from the metal itself highly heated: and if this be the case, the same advantage will still be derived in the present stove from the current of air obviating this effect. The fact accordingly is, that in this stove, if it be managed with common care, no such smell is produced, a circumstance which at once gives it a superiority over every other stove.

2. By the action of a stove raised to a red heat, as common stoves almost always are to produce sufficient warmth, the air must, to a certain extent, be vitiated, from the causes mentioned in the preceding paragraph. In the present stove, as the operation of these is obviated, this deterioration of the air is avoided.

3. In common stoves, the heat is always very unequally diffused. Its sides are raised to a red heat, or near it; and in the immediate neighbourhood of the stove, the warmth is unpleasant, or oppressive, while at a distance it is little felt. In the present stove, the heat being diffused principally by the current of heated air is equally spread. The outer dome is never so much heated as to feel unpleasant; and at the most distant part of the

apartment in which the stove is placed, heat is distributed by the free and rapid diffusion and intermixture of the warm air. The heat, too, is thus not only more equally communicated, but is distributed to advantage, while in common stoves much of it is lost, by being accumulated in the neighbourhood of the stove, and producing inconvenience rather than any benefit.

Lastly, this stove may be easily made to produce ventilation as well as warmth, in situations where this is required. To effect this, all that is necessary is to inclose the apertures at the bottom of the external dome within a circular tube, with which a tube from the external atmosphere is connected. A constant current of fresh air will thus be brought in, and, rising through the space between the two domes, will be discharged warm and perfectly pure. In stoves on the common construction, it is impossible to procure this advantage; and there is even always the temptation to diminish ventilation, in order to procure warmth. In every situation where there is not a very free supply of air, it is recommended to bring in the fresh air in the manner above described, as the same air, when repeatedly heated, must prove unpleasant and injurious.

From these observations, the advantages to be obtained from this patent stove must be apparent; and in the trials which have been made of it, for different purposes, under the direction of the patentees, it has answered the most sanguine expectations.

For heating *churches*, a purpose to which it has been pretty extensively applied in this city, and to the publicity of which the patentees can appeal, no method can be placed in competition with it. Common stoves are always disagreeable and inefficient. To produce any sensible effect, they must be highly heated; the usual unpleasant smell is produced; and in the neighbourhood of the stove the heat is oppressive, while at a distance it is scarcely felt. In this patent stove the heat is diffused equally, by means of a tube connected with the neck of the outer dome, and discharging the heated air by branches at different parts, conducted generally under the front of the galleries. The temperature through the

whole church is thus kept uniform and agreeable, while no unpleasant heat is experienced in the immediate neighbourhood of the stove.

For heating *large halls*, *lobbies*, and *staircases*, this stove is extremely well adapted, as by discharging a constant current of heated air it diffuses an agreeable warmth, without any of the unpleasant effects of a common stove, or the waste of fuel, and the inconvenience of dust and smoke from an open fire-place. It has another advantage in these situations, and also in large *libraries* and *picture galleries*, that the current of warm air completely obviates any dampness, both by the circulation of the air itself, and the warmth it conveys.

In heating *public rooms*, it will be found more economical than any other method, and the due temperature will be established more equally, and with more uniformity. The ventilation it can be made to produce is in this case also a very marked advantage.

It has the same advantages in heating large *manufactories;* and for this purpose it has the farther important advantage, that by tubes branching from the main tubes, it can be applied to heat different apartments, either constantly, or by having covers adapted to the apertures of the tubes, as occasion may require. And by bringing the supply of air from without, it will ensure ventilation as well as warmth.

When constructed of a small size, it forms a stove superior to any other, in economy, and in the other advantages already pointed out, in heating the apartments of a house; and by a small variation in the construction and position of the door, it can be made so as to give the appearance, and to a certain extent, the direct heat of an open fire place.

There are numerous other uses to which this stove may be applied with much advantage, which, however, being less common, require only to be mentioned,—such as the heating and ventilating of ships, ventilating mines, drying various articles of manufacture, &c.

It has frequently been attempted to apply heated air, more or less extensively, as a medium of conveying warmth, as in the

Swedish stove, Franklin's stove, and by brick flues, and various arrangements on a large scale. To these the patentees of course lay no claim; and they may affirm, that the success of them has either been only partial, or that they are not possessed of the advantages of the apparatus they employ. Any portable stove hitherto in use, in which heated air is at all introduced, is still liable to all the objections to which the common stoves are liable, particularly the unpleasant smell, and the excess of heat given directly from the sides of the stove itself; and the inconveniences attending any fixed furnaces with flues, or any other building, for more common purposes, at least, are sufficiently evident. The patentees of the present stove may therefore fairly maintain, that no method of communicating heat has been introduced, possessed of the combined advantages which it possesses,—particularly those of being capable of being constructed on a small scale; of being portable, durable, not complicated, and hence not liable to be injured;—economical with regard to fuel, ornamental in form, and in the highest degree powerful. They therefore submit the invention with confidence to the public.

These stoves are sold at the shop of *Adam Anderson*, No. 51, South Bridge-street, Edinburgh, one of the patentees, by whom also are sold the tubes which are connected with it for different purposes.

From the above description our ingenious Iron masters will find no difficulty in casting these stoves. *Edit.*

ON THE APPLICATION OF LIME TO LAND.

ONE of the means by which the agriculture of Pennsylvania has so greatly improved within the last thirty years, is the liberal use of *Lime*. On this subject the agricultural books of Europe, and especially of England, abound with a variety of contradictory theories, and even many of their FACTS detailed by practical men, will not apply to this country, owing to the great difference between our soils and theirs. It is to our own farmers that recourse must be had for accurate information respecting the most economical mode of applying this important substance to land,—its duration, and effects. The agricultural reader will therefore prize the following papers. In a future number of the Archives, the Editor will give additional information on the subject, particularly a paper containing an analysis of the various lime stones in the vicinity of Philadelphia, which have been most commonly used on land. *Editor.*

Some hints concerning Lime, occasioned by reading Darwin's Phytologia,—By John Lang.*

From the Memoirs of the Agricultural Society of Philadelphia, vol. 2d.

Read August 9th, 1808.

WE have for some time past heard much about two varieties of lime, the one useful or favourable to the growth of vegetables, when used as a manure; the other hurtful or pernicious, and therefore not to be used for that purpose; the first is termed calcarious, the other magnesian lime.

The first notice we have of this magnesian lime is from a communication of Mr. Tennant, published in the London Philosophical Transactions.

This is doubtless a subject of great importance to farmers, and in my opinion deserves to be more fully investigated. If all lime which contains magnesia is only *useless* as a manure, it must be of great importance to our farmers to be informed how they may be able to distinguish this from the calcarious lime; but much more so if it is as Mr. Tennant says, destructive to vegetation, and that it *diminishes* the fertility of the soil. The distinguishing characteristics of these two varieties of lime, mentioned by through the sides of the heaps of it; but at the same time it would

* Or the philosophy of gardening and agriculture.

Mr. Tennant, it would seem, can only be discover ed either by analysing, (which process farmers are generally ignorant of;) or by making experiments by applying it to the soil. It is said that magnesian lime when used in too great quantities renders the soil less fertile, and wherever a heap of it has been left on one spot, vegetation will be prevented for many years; while of the other sort of lime, a large quantity is never found to be injurious; and that the spots which are entirely covered with it, become remarkably fertile, instead of being rendered barren.

From the above statement it would appear, that by far the greatest proportion of all the limes used either in this country or in Europe are of the magnesian kind, or in other words must contain a certain proportion of magnesia. For my own part I have never seen pure calcarious lime, unless that made from calcined shells may be denominated such; though I must own I am not chymist enough to be able to discover the magnesian lime, except by its effects upon the soil, as above described by Mr. Tennant, and Dr. Darwin. The distinctions which some farmers make, of hot and mild lime, Mr. Tennant believes to mean magnesian and calcarious lime. And the Doctor says he is informed, that the magnesian lime is preferred in architecture, and is said to go further in making mortar, &c. If this is the case, I think it will be admitted that all the lime used in the United States, either for building or manure, is of the hot or magnesian kind;* as it is well known that the lime of this country is generally stronger, and of course will go further in making mortar, or as a manure for land, than English lime. Were our farmers in this country to discover lime of so mild a quality that thistles and grass would grow up

* Since writing the above, I am informed that there is in Marlborough township,† Chester County, in this state, a mild lime which answers well on land. But it is a notorious fact, that the great body of improvers, use hot or caustic lime with success; but clover ought always to be sown with the first crop. And though in some instances the grain crop may seem little benefited, or even injured by the lime, the clover and succeeding crops will show its effects.

† See the mistake corrected in the next paper.

require three loads of this lime to produce the same effects upon their land as two loads of the lime now in use, I think they would surely prefer the latter to the former. Our farmers know very well, that wherever they lay their lime heaps, every particle of grass or other vegetables will be destroyed; and that the spots on which it lay will not bear any crop for a year or two after, unless they are careful to remove it so clean, that no more shall remain on these spots, than the same proportion which they spread over the rest of the field. They likewise know that if they should leave their lime heaps exposed to the influence of the atmosphere, to successive frosts and thaws, rains and snows, &c. it would in time become as mild as the calcarious lime described by Mr. Tennant. But then it would be useless for mortar, and for land it would be like some medicines of which the chief recommendation is that if they do no good, they will at least do no harm; and for that reason they commonly cover the heaps over with sods, or straw, &c. till the land is prepared for putting it on. Our farmers likewise know that poor land will not bear so much lime as rich land, and that if they should by mistake over-lime their land, the succeeding crops will rather be hurt than benefited by it; and in such cases there is no remedy but either to give the field a dressing with dung, or let it lay a year or two till the heat of the lime is partly given out, and then it will have its effect. From this I conclude that lime must act as a stimulant, and that the quantity applied to the land ought to bear an exact proportion to the carbonic, or vegetable matters contained in the soil. It is well known that stimulants used in small quantities are in some cases very useful in the animal economy, but in great quantities they will destroy animal life.

I would not by any means presume to call in question the results of Mr. Tennant's or Dr. Black's experiments; on the contrary, I am rather inclined to believe, that all stone lime contains a greater or lesser proportion of magnesia; but that the lime which contains the greatest proportion of that earth, is totally unfit to be used upon land as a manure, I think, deserves a second consideration.

Dr. Darwin observes that the substance called chalkstone is almost wholly magnesia; now I know from experience that chalkstone land is the most kindly to all sorts of grain of any soil I am acquainted with, and will bear a longer succession of severe cropping before it is exhausted. But perhaps it is the process of calcination which gives to the magnesia that caustic quality which renders it so hurtful to vegetation, as Mr. Tennant found by his experiments, that thirty or forty grains of lime did not retard the growth of seeds, more than three or four of calcined magnesia. From which Dr. Darwin concludes, that, as both injure vegetation in large quantities, they may both assist vegetation in small ones.

Consistent with the Doctor's remark I would just observe, that there are many substances which make rich manures, when used in small quantities; for instance, I have seen very great crops of barley got by sowing the land with pigeon's dung, as thin as we sow rye, and harrowing it in along with the seed barley; whereas had it been put upon the land as thick, or half as thick as we would put stable or barn-yard dung, it would as effectually destroy all vegetation as hot lime used to excess. The same remarks will apply to the dung of all kinds of domestic fowls, also to human dung and urine, so much valued in China. Common salt has often been recommended as a great assistant to the growth of vegetables when used in small quantities, whereas it is well known that the excessive use of it will render land totally barren.

It will be admitted on all hands, that all animal and vegetable matters contained in the soil, must undergo a decomposition by some means or other, so that being thereby reduced to such a state as to be easily soluble in water, they may be readily absorbed by the tender roots, by some termed the mouths of plants. That the roots of plants naturally possess to a considerable degree the power of producing this decomposition, I have had occasion more than once to observe, in the case of planting potatoes with woollen rags instead of dung. I have seen fine crops of potatoes

raised by dropping a small piece of woollen rag,* nor larger than the hand, in the furrow along with every sett of the potatoes when planted, and I have observed when the potatoes were gathered in the fall, that, in every instance where a potatoe plant had failed to vegetate, the rag was turned up entire, very little damaged by being buried under ground; whereas on the other hand, not the smallest vestige of the rags were to be seen in any part of the ground where the plants had succeeded and grown to perfection. Only I observed in some instances where the rag had been uncommonly large, a white mouldiness upon the soil about the roots of such plants, which seemed to me an indication that more nutritious matter had been formed than could be absorbed by the roots. Besides I observed the palms or tops of such plants were always large, and of luxurious growth, while the potatoes at the root were small and not fully ripe.

But there are other animal and vegetable substances which require more powerful solvents to prepare them for the food of plants; such substances must be decomposed either by means of the putrid fermentation, or by the application of hot lime, &c. But while the putrid fermentation is going on, it is exceedingly

* Before the revolutionary war, I collected many cart loads of taylor's rags, chiefly woollen. Some I had cut in small pieces; others were ploughed in, as they came from the shops; after having been scattered by hand so as barely to cover the surface of about three acres of loamy land, much worn. I had a remarkably fine crop of *potatoes*, succeeded by a great crop of wheat. On this clover was sowed. It lay for many years without other manure except plaster, in green grass after the clover. The effects of the rags continued longer than those of any manure I ever experienced; and I think the part of the field on which the rags were strewed, is the best spot in it to this day. It has been all limed, dunged and plastered alike from time to time; and the soil of the whole field is similar in all parts.

R. PETERS.

March 27, 1810.

Rags chopped, and sown by hand, and ploughed in three months before sowing wheat or barley, the quantity six to ten hundred weight per acre, are used in England with success. In Kent, they spread a ton per acre every third year for hops. As they hold moisture, they are adapted for dry gravelly or chalky soils, and succeed best in dry seasons.—'*Gleanings of husbandry.*'

J. M.

noxious to vegetation, as we may see by the bad effects of putrid or stagnant water upon the roots of tender plants; while on the other hand, hot lime will check the progress of putrefaction, and at the same time very quickly effect the decomposition of various bodies; thereby preparing sweet and wholesome juices, whether they consist of carbon, phosphorus, oils, or alkali, or compounds of all or either of these. And I conceive if the lime meet with a sufficient quantity of such substances as it in this manner acts upon, it will by mixing with such juices, thus prepared, be thereby deprived of its caustic quality, in the same or somewhat similar manner to that whereby magnesia or chalk blunts, or sheaths the points of the sharp particles of acids. But if the lime does not meet with a sufficient quantity of carbonic or other matters in the soil to act upon, so that its caustic quality may be completely overcome, then in such case it will act upon the tender roots of the growing plants, in the same manner as it acts upon grass or other vegetables when laid in heaps on the surface. And this is in my opinion the cause why lime in some instances is hurtful, instead of being beneficial to land.

Upon the whole, I think, instead of troubling our farmers about distinguishing the different qualities of magnesian and calcarious lime, it will be better to advise them to use lime sparingly on poor land, and at the same time to use every exertion to increase their dung and compost heaps, whereby their land will be prepared for the application of lime, not only with safety, but great advantage.

Philadelphia, July 12, 1810.

SIR, Read August 14, 1810.

I CONCEIVE it a duty I owe the Society, to communicate through you, the result of some experiments which I had set about, for the purpose of ascertaining the best means of reclaiming old worn out land. I had fondly listened to the method proposed by some, of improving, with clover and plaister, without the use of lime; and determined to try it. The field which I pitched upon for my experiments contains about fourteen acres;

it had been cleared about fifty-three or four years ago, and continued in constant cultivation for upwards of thirty years, without manure of any kind. Some old people now living, say that they have seen as good crops of wheat cut from it, as ever they saw; but it was kept in cultivation till the produce would no longer pay for the labour, and has been thrown out a common for more than twenty years, 'till I fenced it in. I had the whole of the field ploughed early in the spring of 1808; in the month of May one part of it was ploughed again, and sown with buckwheat; this buckwheat was ploughed in when in blossom, and the land sown with buckwheat a second time, which was likewise ploughed in and sowed with rye.

The other part of the field was limed, at the rate of 25 bushels to the acre, and planted with corn. The lime which I used was of the hot kind, from a quarry which is generally approved of for land in those parts; makes very strong mortar for building, but is not used for plaistering, being granulated and not very white. I suppose it to be similar to that described by Dr. Darwin, which he supposes to have been primitive lime, broken down by the action of water and petrified a second time, which he thinks is the strongest lime.

The following summer was very dry, which together with the heat of the lime, I supposed to be the cause why the corn became stunted and produced almost nothing. In the spring of 1809, the land was ploughed and sowed with oats and clover, the other part of the field which was now in rye, was likewise sowed with clover at the same time, and as soon as the clover began to appear above ground, the whole field was sowed with plaister.

At harvest the oats was a very good crop, the rye was tall and well eared, but rather thin; perhaps it was owing to this circumstance, that the clover among the rye looked better, and more plentiful than that among the oats. I had not seen it until Wednesday, the 4th instant, when I found that part of the field which had been limed, closely covered with fine clover, whereas on that part which was not limed, almost the whole of it had perished last winter, and what plants remained were weak and sickly, and abun-

dance of wood-grass beginning to appear, with which the field used to be almost covered while it lay a common; whereas not one plant of it is to be seen on that part which was limed. From this I concluded, that if the system of improving with clover and plaister without lime, should succeed in the end, it must be by a number of repetitions of the same process, which would require time and labour equal to, if not exceeding the expense of lime, and the result uncertain. I therefore ordered that the part of the field which had not been previously limed, should be limed as soon as possible, twice ploughed, and sown with rye, and clover next spring.

It was the opinion of the man who farms for me, as well as of others who made observations, that I missed it by planting corn with the lime; that if I had sown oats and clover the first spring, I would have had a profitable crop, besides gaining a year in my improvement, which was lost by the failure of the corn crop, and part of the strength of the lime exhausted to no purpose.* I am fully aware of the objection which some have to oats as an exhausting crop, and therefore ill calculated for advancing the improvement of worn out land. At the same time that I disapprove of the absurd practice of some farmers, of sowing oats and buckwheat, year after year, as the worst of all rotations; I am convinced from long experience, that an occasional crop of oats is no more exhausting than wheat, rye or corn; that it is an excellent nurse for clover, a profitable crop for the farmer, and the straw

* However corn may succeed upon fresh limed land, in cases where the land was in good heart previous to the application of the lime; I here give my opinion, not from conjecture, but experience and observation, that in general it will be found better for the land, and more profitable for the farmer, to defer either corn or wheat, until clover have first intervened; especially if the lime was of the magnesian kind and the land poor; and then the addition of a little dung will be very useful. And in this opinion I am partly borne out, by that able and experienced farmer Judge Peters, president of this society; in a note at the bottom of page 280 of this volume, he has these words, "The same fields (where wheat had failed) produced clover in abundance. In their next turn for wheat (and especially if assisted with a light dunging) they amply retributed my former disappointment."

good fodder or litter, without which he cannot get much dung, the value of which is not sufficiently appreciated by many of our farmers. Every kind of grain which ripens its seed is an exhauster, even clover, which is the most ameliorating crop which we know, if it is but a moderate crop and left standing until its seed is full ripe, instead of improving will be found to exhaust the land.

Before I conclude I must take some notice of the mild lime, which I mentioned in a note at the bottom of page 20. I then supposed the mild lime above mentioned, to be the property of Mr. Barnitt of Marlborough township, but when I was with my friend Mr. John Mills on the 4th instant, he told me that Mr. Barnitt's lime is the hottest and strongest lime in that neighbourhood, that the mild lime which I alluded to is the property of Mr. Baker of Newlin township. The two limes are not more than two or at most three miles apart. Mr. Mills's farm lays nearly in the centre between the two, and he occasionally uses both. He says that it requires 130 bushels of the mild lime, to go as far on land as 100 bushels of the hot lime;* that the mild lime is in its effects on land somewhat similar to that of dung, as it gives out its strength to the first crop, but in one or two crops more it is all gone; whereas though the hot lime sometimes, instead of helping, rather injures the first crop, its good effects continue for many years. He showed me a clover field, one part of which had been manured with Mr. Barnitt's hot lime, and the other with Mr. Baker's mild lime. I observed that wherever a heap of the hot lime had lain, not a blade of vegetation of any kind had appeared, though Mr. Mills told me that every particle of it was shovelled off as clean as possible; but on that part of the field where the mild lime was put, no such effects were produced. He told me further, that the grain was best on that part where the mild lime was put, but the clover is greatly superior on the other part, (it was all plaistered alike) and I have no doubt that the succeeding crops will evince a decided preference, in favour of the

* This last brings a higher price than any lime in that neighbourhood, or from the valley; being esteemed so much more valuable, as it goes farther on land, &c. than either of these.

hot lime. I expect to procure specimens of both the above limes, for the purpose of having them analyzed.*

Analysis of American Limestone. By J. Cutbush, Chemist and Apothecary.

Philadelphia, 13th September, 1810.

SIR,

I have made the necessary examination of the lime stones you wished me to analyze. The comparative quality, with respect to the ingredients of each kind (hard white, and black micaceous) we may, therefore, the more readily judge of.

While one variety, on the one hand, according to my experiments, correspondents to that mentioned by Mr. Tennant; the other appears on the contrary, to be composed of more calcareous

* Having procured specimens of the above varieties of limestone, and by the polite attention of Mr. James Cutbush, have been favoured with a chemical analysis of each of them, (for the results of which see the letter annexed) we are enabled to judge of the striking similarity, between these and the specimens which were analyzed in England by Mr. Tennant some years ago, as particularly noticed in the London Philosophical Transactions, and in the writings of Mr. Henry, Dr. Darwin, and others.

We may remark, that while the learned theorists in England and elsewhere, were exulting over the grand discovery, whereby the farmer might proceed with certainty in his choice of the lime most proper for manure, as if none but the mild or calcarious kind, would henceforth be used for that purpose; in the mean time, we find the great mass of practical farmers, whose practice is generally the result of long experience and observation, who read very little, many of whom seldom or never see a newspaper, far less the London Philosophical Transactions; who never heard of Mr. Henry, nor Darwin's Phytologia; who are entirely ignorant of the grand discovery of the calcarious and magnesian limes, still giving the preference to the hot or magnesian lime, and paying a higher price for it, even where the mild kind is equally within their reach, notwithstanding they know as well as Mr. Tennant, that the spots where the heaps of it had lain will remain barren for at least two years to come; they being at the same time sensible, that with a judicious rotation it will produce them improved crops for a number of years, whereas the beneficial effects of the mild lime will be all gone in two years.

J. L.

earth, and I presume would answer all the desirable purposes of agriculture.*

With respect to the limestone, when it comes under the head of magnesian limestone, agreeably to the name of Mr. Tennant, I would merely remark, that when the magnesian earth exceeds a certain *per centum*, it might with strict propriety be referred to this class; for in most of the varieties of limestone, the magnesian earth is more or less abundant.

The characters of the limestone, which answers to the magnesian limestone, are, its extreme hardness, striking fire with steel, in consequence of which it must contain a large portion of silica; slow solubility in muriatic acid, &c.

The solution, when effected in muriatic acid, was tested with carbonate of potash after filtering it, which produced a copious precipitate. Oxalate of potash, added in a similar manner, also produced a precipitate.

The last experiment decided the presence of lime, and the former in a great measure, the existence of magnesia. To ascertain this fact, however, with more certainty, a portion of the solution was examined with carbonate of ammonia, and the precipitate formed, was separated. The filtered liquor was now examined with phosphate of soda, which occasioned a copious precipitate. The quantity of this appeared to equal the quantity obtained by oxalate of potash in the former experiment, or that caused by the carbonate of ammonia immediately preceding. On examining the precipitate formed by carbonate of ammonia with muriatic acid and oxalate of potash, the whole was discovered to be carbonate of lime.

* Mr. Cutbush in this instance falls too hastily in with Mr. Tennant's hypothesis, in giving the preference to the calcarious lime, for agricultural purposes. Whereas it is a fact well known, that Mr. Barnitt's lime above noticed, (which agrees with Mr. Tennant's magnesian kind) fetches a higher price than any other limes in these parts; and such is the demand for it, that it cannot be got burnt fast enough. When it is known that a kiln is ready, the wagons come the night before it is opened, and next morning they never stop loading until the whole is finished. This is sold at fifteen cents per bushel at the kiln, while the others are bought for twelve and an half cents per bushel. J. L.

The phosphated soda, according to Dr. Wollaston, added after the carbonate of ammonia, in the manner of which I have spoken, (when the carbonate is used in the common temperature of the atmosphere) is the most accurate test for the discovery of magnesia.

The experiment for determining the presence of magnesia was made in a general way, in fact, merely to ascertain if this earth existed under the circumstances we have already stated.

The other specimen of limestone, which is far more friable, and of a dark miscaceous appearance, was soluble with more facility in muriatic acid. The solution was soon effected; the addition of carbonate of ammonia separated the lime in an abundant precipitate; and the filtered liquor, after adding the carbonate, gave a slight precipitate with phosphate of soda. Magnesia, however, as already stated, is always found more or less accompanying lime.

With much respect, sir,

I remain yours, &c.

JOHN LANG. JAMES CUTBUSH.

On Liming land. By Richard Peters, President of the Agricultural Society, Philadelphia.

From the Memoirs of the Agricultural Society, Philadelphia, Vol. 2.

Read Aug. 14, 1810.

THE relation to the society in which I am placed by them, impels me to bring to their notice, many subjects, which I should not otherwise conceive myself bound to discuss. When no attention appears to be paid by others, to an important point, I venture to supply, however inadequately, the deficiency. This must be my apology for so often troubling them with my thoughts on topics, to which others, if so inclined, could do more ample justice. We have not a solitary communication upon the practice of *liming land;* though carried to very great extent in our state. In no country is *lime* in more abundance; nor can it be of better quality. Chemical and theoretical accounts of it, may be found in many books. There are good writers on its properties, as they ap-

ply to agriculture. But we find in those writers, many positions and remarks, both theoretical and practical, unsuitable to the climate and circumstances of this country. It is more a topic for curiosity than practical use, with common farmers, to enter into its composition chemically; though to those who turn to profitable account such inquiries, they are indeed highly beneficial. I leave all theories; and wish to call the attention of the society to its practical uses. It would be very desirable to fall on means to acquire every information from those who can, from experience, give it; and multitudes of our fellow citizens have the capacity to afford the fullest satisfaction, in every point of practice required. It is more necessary to excite the inclinations of many of them to communicate their practical knowledge, than it is to give them instruction; as this substance has, in many districts of our country, now become one applied in common course. It is annually becoming dearer to the farmers in old settlements, and especially in the vicinity of the city and large towns; owing to the demand of this material for buildings, and the scarcity of timber for fuel. From twelve to fourteen cords of wood are consumed, in burning one kiln of lime of six hundred bushels. The quarries are inexhaustible. No other fuel equals wood for this purpose; as we may see by comparison of ours with the lime of our coal counties, where it is tinged and discoloured, and vitiated by the sulphur of the fossil coal used in its calcination. It would be on these accounts desirable to offer a premium, or, in some way, to encourage improvements in the construction of lime kilns; to save the consumption of fuel.* Coked coal might, where timber is exhausted, supply the place of wood.

* In our western country, *pit-coal* and *limestone*, of the first quality, are generally, and in great plenty, found on the same spot, in strata of from four to six feet in depth, or thickness respectively; above or under each other, as they happen to be naturally placed. Coal may be as easily charred or coked (and much in the same way) as wood burnt into charcoal. In that country, furnished with such abundant means in all quarters, manufactures, are rising, and may increase, with time and population, to an incalculable extent. Cheapness of produce will forward them. Domestic markets will be created, to

The quantity, per acre, proper for soils of different textures is by no means fixed, either here or in Europe. I have been surprised, by what I have myself seen, and more by the accounts I have read in European books, at the great, and to us incredible, quantity of lime allowed by Europeans to an acre. Ours is the statute acre of 160 perches. The common computed acres of Europe differ in contents; so that it is difficult always to understand what is meant by writers, even in England, by the term *acre*. But the lime of Europe, applied in the quantity of 160 bushels to a statute acre of 160 perches, at one dressing, must either be of inferior strength and quality to ours; or there must be a vast difference in the effects of climate. As to soils of most countries, they are much alike. There is not, on our globe, better nor worse land, with all the intermediate gradations, than can be found here. It is composed of all the varieties of materials, generally found in soils of other countries; though no accurate analysis, of quantities and proportions of these materials, has been made. It would be highly useful, that geological explorations and inquiries should be more generally prosecuted throughout our country. Every farmer should analyze his own soil;* that he

stimulate and reward the labours of husbandry: and thus the inconveniences of the distance from the ocean, will be amply compensated. Although wood (to preserve which they take no care) may be now in plenty, the coal will be in the greatest demand. Most of the heavy materials used in the Staffordshire (English) potteries, placed where they are principally on account of the coal for fuel in many parts of that coal country, are transported from a distance of 100 miles and upwards. Steam (in our western country) must be substituted for water powers, where the streams fail for several months in the year, beyond the western mountains.

It is to be much regretted, that the lower, or Norristown canal scheme has been interrupted, or failed. Marble, limestone, lime, soap-stone (as well as building stone) in inexhaustible plenty, could, by this means, be supplied; and delivered in the city for domestic purposes, or exportation.

* There is an excellent treatise, "on the analysis of soils connected with their improvement," by the celebrated Professor DAVY chemical professor to the British board of agriculture. This might be read with instruction by one versed in such subjects; and rendered more intelligible to practical farmers; though I think it sufficiently plain in the most necessary directions. Our

may be the better enabled to cultivate to advantage, by knowing its texture and applying the manure the most suitable to it. THREE HUNDRED BUSHELS *(Winchester)* of lime, have been, at one time, spread on an acre, in England! Half of that quantity, laid on at once here, would ruin any acre of land within my knowledge. I mean a worn acre taken up for amelioration and recovery. Land reduced to sterility, by bad farming and over-cropping, is like the stomach of an animal in a state of debility. It must be recovered by gentle means applied repeatedly, and at proper intervals. Too much food is as destructive to the animal, as over-liming is to the impoverished land; whatever may have been the original stamina of the one, or qualities of the other. It is essential to know what quantity per acre, is advantageous and proper *here;* and the most beneficial modes of using it. When I began, in the early part of my life, to lay on lime, I was advised that the lime would spend itself as much if no culture were carried on, as it would by the severest cropping. I soon found that limed lands required as much care and good management, as others.

extract from Lord Dundonald in vol. 1. is highly worthy attention, and can easily be practised upon.

The use of analyses of soils is very properly stated to be, for the purpose of enabling us to find and supply the defect of proportion in the primitive earths. Mr. Davy truly observes——

"In supplying animal or vegetable manure, a temporary food only is provided for plants, which is in all cases exhausted by means of a certain number of crops; but when a soil is rendered of the best possible constitution and texture, with regard to its earthy parts, its fertility may be considered as permanently established. It becomes capable of attracting a very large portion of vegetable nourishment from the atmosphere, and of producing its crops with comparatively little labour and expense."

It was to encourage our farmers and others in pursuits, having this object in view, that we offered our first premium, in 1806, for "ascertaining the component parts of arable land." This (and most others of our endeavours to promote a spirit of improvement) has been too little attended to. While farmers are regretting the want of dung, lime, and other artificial supplies, they overlook materials for permanently fertilizing their fields, to be found on their own farms.

R. P.

The lime may sink, or part with its qualities; but severe cropping and bad systems, injure limed, as much as other soils; and, I think, leave them in a state more difficult to recover. I have myself experienced this, when I over-limed or over-farmed, from want of proper information. I therefore suspect, that the lands said, in many places, to be *lime-sick*, must have been badly managed, and over-worked. And yet in some parts of our country wherein they have discontinued the use of lime, after having long applied it (perhaps in two great quantities) there are good farmers. I believe land requires a change, after a certain time, of manure as well as of crop; though either may be, after proper intervals and with suitable auxiliaries, again introduced with equal benefit. I do not know enough of facts, relating to *lime-sick* lands, to give an opinion: and this is one among other reasons, why I wish the society to promote inquiries.

I believe it is generally known and agreed, that the poorer the land, either naturally or by wearing, the less lime it will bear. So that 25 bushels will benefit, where 50 would injure. Lime, being in itself no manure, must find, in the earth, or in the air, something to act upon, or co-operate with. And, that it may have constant communication with the atmosphere, it should be kept near the surface; both in its first application, and by deepening the ploughings to bring it up when it sinks. I have made much use of it, in every way, and in great quantities, for a long course of years. My soil is various; but generally a kindly loam, mixed with *mica* (isinglass) and in parts sand, as well as clay. The surface is of every description, as to exposure, hill and vale. It had been much worn in some parts; and I have cleared off, from time to time, a considerable portion of the timber. So that I have had all kinds of soil to operate upon. I have generally begun with 40 bushels (sometimes 50, and often 30 and 35) to the acre. I prefer it to be laid in half bushel-heaps, and water-slacked. But I frequently cover these little heaps with earth, and leave it thus to slack; closing the cracks carefully as they appear. Sometimes I leave it through the winter, in large heaps of 40 or 50 bushels (accordingly as I determine the quantity per acre) well

protected by earth and sod. I choose, when practicable, to spread it in the autumn; and either plough or harrow it in. The next season I take only a summer crop. Indian corn I think the best; as its culture mixes the lime most effectually with the soil. I have most frequently put lime on in the spring; and I have cropped fields with winter-grain, when limed in the same season. I have sometimes succeeded with *rye;* but when *wheat* was sown on land fresh limed, I have invariably suffered by mildew, smut, rust, or blight. I scarcely remember an instance to the contrary. The crop is retarded in its maturation, by the lime; and though it shows a deep verdure, and large heads, the former is as deceptive as the blush of a hectic, and the latter seldom or never fill.* Yet in some European books, I see it recommended, to

* It would seem that the fresh lime, acting on the substances in the earth with ruinous energy, pressed on the plant more food than it could digest or contain; and produced death by a fatal *plethora*. With a good glass one can plainly discern the bursting of the vessels and the extravasation of the sap, with all their consequences. The grain is shrivelled, though the plant, until its catastrophe, appears to thrive. If winter crops on fresh limed lands come to maturity, they ripen late; and their risks of mildew are increased. I have observed this even when dung is used with fresh lime. But with lime alone on exhausted lands, where little or no vegetable or animal matter is found in the soil, I have seen wheat a starved and worthless plant. Summer crops only should be sown on land fresh limed; and Indian corn is the most suitable. When I repeat the liming, as I have generally done with a greater quantity than that first applied, I commonly take a crop of Indian corn in the year before wheat; to *kill the lime*, according to the country phrase. The corn, being a gigantic plant requiring large supplies, will thrive on all the food that lime can furnish or prepare.

When I began to lime (45 years ago) I had no practical instructor; for it was a novelty in my neighbourhood. I have lost whole fields of wheat on limed lands sown the first season of liming, in a few days after the deceptious verdure of the plant had induced me to count on a plentiful crop. The same fields produced clover in abundance. In their next turn for wheat (and especially if assisted by a light dunging) they amply retributed my former disappointment. My success was much increased after I used plaister on the clover crops; which ameliorated the soil, and furnished vegetable matter for the lime. A moderate liming, (say 30 to 40 bushels to the acre) harrowed in on fall ploughed ground, and laying exposed through the winter,

plough or harrow in the grain and lime together. I have never approved of dunging the ground at the time of liming; having made comparative experiments. My course has been, to lime,—take a summer crop,—fall-plough,—and, the next year, an open fallow, or a covering, but inexhausting spring-crop, preparatory to dunging for wheat. In this course I have invariably had success; and therefore prefer it to any other. I have, when the field came in course again (in three or four years) limed; and thus repeated the applications to 120, and in one field, to 160 bushels to the acre; including all repetitions of liming, at different, and distant periods. I have known 80 bushels to the acre (put on, at once, on such land as mine) injure the field for several years; or until recovered by dung, or green manures ploughed in. It is said that clay will bear the heaviest liming. So that climate, strength and quality of lime, (I mean stone-lime, as ours generally is) differ widely in this, from those of other countries.

Farmers of what are called *strong lands*, have told me, that eighty bushels per acre, on the first application, were but a moderate allowance. But I have ever believed that it would have been better to lay on forty or fifty bushels in the beginning; and increase, by repetitions, after proper intervals. Strong lands are precipitated into debility by over stimulation, as strong men, or other animals, are enfeebled by excess, or over exertion. Some of our strongest lands are now thus reduced to a situation to be no longer benefited by lime. In lime-stone countries, where lime is obtained on easy terms, I have known it spread without rule, or attention to exact quantity. I always predicted, that repentance would, one day, follow when too late, this agricultural enormity.

In *Europe*, lime is heavily spread on a tough old grass lay; and it meliorates the grass, so as to render it highly palatable to cattle, and hastens their fatting. It lies thus, twelve months,

will part with most of its caustic qualities, and do with dung the succeeding spring, or autumn. But it would be much better to intermit *wheat*, for another year.

(having been put on in the autumn) and the field is then ploughed, and taken up for a course of crops; preparatory to being laid down again in grass. In this way, it is alleged, and it seems reasonable, that land will bear the heaviest liming; especially if it be a strong clay; though it is known to benefit lighter soils the most.

Lime on clay has never succeeded with me, to any profitable extent. The idea of its durably warming cold clayey land, is unfounded. Heat is disengaged, when water or moisture solidifies, while lime is slacking: but it becomes shortly thereafter, a cold substance.* Its particles are two small and fine to keep asunder

* Moss or a green fungus, such as is seen on damp north walls, stones, or on the buts of trees growing in cold soils, will be often found on the ridges of limed lands, in great plenty. I have considered this as a sign of coldness, rather than heat, in the lime. I have conceived that hot, dry, and light soils were benefited and corrected, by the *cool* and binding quality of the lime; as well as by its attracting and retaining moisture; independent of its other qualities. Mosses are found in all kinds of land, and especially in wet and cold soils. I think they abound on limed lands, in by far the greatest quantities.

See Mr. *Lang's* observations on LIME; which are well worth attention. I unwillingly meddle with conjectures, however plausible they may seem; leaving them in better hands. It is known however, to every body, that *lime*, after parting with its fixed air, thirsts for its recovery. I therefore believe with Mr. *Lang* that it preys on the plant, for lack of other supplies; and attracts all the carbonic acid it can obtain. And this is its process, rather than durably warming the land. Dung gives it the pabulum it wants, both for its caustic and attractive qualities;—so do vegetable substances found in the earth;—of which poor and exhausted land affords the fewest; and therefore will bear the least lime. This fact I know;—its theory I will not insist on;—lime certainly (especially when applied fresh) retards maturation; and exposes the wheat crop to injury, if not to ruin. I have repeatedly found that dung, in equal quantities, put on the year of liming, is very inferior in profitable effects to that applied in the year succeeding the laying on the lime. In the contemporaneous application with lime, part of the dung is consumed, and goes to balance, or remedy, *an evil;* instead of wholly operating to effect a positive *good;* as it does when the lime, by losing its causticity and *predatory* qualities, is prepared to co-operate with the dung, in the salutary and beneficial purposes intended by their combined application.

The lime, when it has spent its noxious activity, operates as a mild solvent

those of the clay; and such things as produce this effect are the only proper auxiliaries for clay land. Gravel, sand, shells, unburnt limestone, are better than lime. In clay ridged and drained, and kept dry and friable, lime may be serviceable.

I have spread lime on a clover lay, and suffered it to remain on the surface, through a winter; then ploughed; and the lime being well incorporated by heavy drags or harrows, I have found it a very advantageous mode. I have always preferred, in this and every other mode of application, laying on the lime, and mixing it thoroughly with the soil by frequent stirrings, without dung. I have repeatedly observed, that fresh lime and stable manure, put on together, are by no means so efficacious, as when the latter is applied in the season succeeding the liming: green manures, with fresh lime, do better. Lime, like salt, in very *small quantities* is *septic*, and may with dung be useful: but in the quantities usually applied, it must be injurious, on chemical principles, and in fact, to both the land and dung; which latter *flatters* in its effect on the crop, compared to one with lime alone; as dung will always show itself in a greater or less degree; but it will show and act most effectually, when it is not neutralized or consumed by fresh lime.

The varieties of our lime, as to strength or composition, for either masonry or agricultural uses, have been very little attended to. It would be important that some simple test or trial of the qualities of lime, should be established and promulgated. I know that there is in practical result, a great difference in the effects of equal quantities in bulk, measured, or weighed; and the lightest is commonly the best. This I supposed was owing to its being better burnt; so as to have less core. It is but recently, that this subject has been, in Europe, minutely examined. Some kinds of lime have been found, *there*, so composed, as to be prejudicial to agricultural operation. *Here* lime differs widely in effects, on

It attracts, and elaborates the acids in the dung, and the vegetable or other substances in the earth, and prepares them to enter the plant, and to become its food and essential nourishment. R. P.

land or crops; so as to require greater quantities of one kind, than of another. I have found it so, in mortar.*

It will be perceived, that I have avoided, (as much as possible,) technical disquisition. If I have not mentioned any thing new to experienced farmers, or others acquainted with the subject, I have, at least, endeavoured to set an example; so as to invite their communicating what they know to be instructive. Putting a subject *in requisition*, always arouses attention; and draws forth

* If some patriotic chemists would assist us in analyzing lime from every quarter of our country, great advantages would be derived to agriculture. We volunteer our services; and so must chemists. Our limestone is of great varieties of texture, colour and composition.

Without knowing the composition of the lime which gave rise to my observations in the text, which are grounded on facts within my own knowledge, I am now satisfied that where the greater quantities were required, the lime was mild lime. I remember since Mr. Lang mentioned the subject, many instances where the lime soon exhausted all its powers. And I have always found that small quantities of strong (or according to Mr. Lang's ideas, magnesian) lime were more serviceable and much more durable, than larger quantities of that which must have been of the mild species. From one lime-burner I always had what I called weak lime; and discontinued dealing with him. The discovery of the component parts of our lime generally, would diminish the surprise I always feel when I read or hear of the vast quantities applied to land in Europe; and it would account for the small quantity of our lime, proper for our land. The Europeans must use what is called mild lime; and we the strong or magnesian kind. Their lime cannot be many degrees stronger than chalk; which also being a species of lime, contains the cretaceous or carbonic acid. Should our investigations of lime, proved by practical tests, turn out as now supposed, we shall correct another European error, on the subject of lime. It was long believed in England, that lime and gypsum were hostile. Yet they knew that the gyps is itself a sulphate of lime; and therefore that it ought to have appeared reasonable, as we find it in fact, that there is no hostility.

As to the point—whether the lime we commonly use is or is not of the magnesian species, it yet depends on more extensive examinations than have, in this early stage of inquiry, been made, before a decisive opinion can be formed. So far as the experiment Mr. Lang mentions reaches, the proof appears strong. And if specimens of limestone in other quarters produce, when analyzed, the like results, the point will be indisputably decided.

September 17th, 1810. R. P.

useful facts; and discussion conveying instruction, which would otherwise remain hidden, or confined to the knowledge of a few individuals. What may be familiar to experienced agriculturists, is nevertheless highly acceptable, and essentially instructive, to those who want practical knowledge.

ON THE FIRST

PRINCIPLES OF AGRICULTURE.

From the Edinburgh Farmer's Magazine, June, 1809.

WITHOUT the knowledge of first principles, nothing can be expected from any of the practitioners of agriculture worthy of attention, their practice being merely a copy from that already established, if not some gross deviation perhaps from the beaten track, by means of some erroneous idea of their own conceiving. Men acquainted with first principles, will never deviate from them, while they find them correct: perhaps they may try some experiment consistent with them, and succeed. This, then, is the foundation from which we are to expect a rational system of agriculture, adapted to all the varieties of soil, climate, and seasons, with which it must ever be connected.

It is true, that by means of great attention to, and a careful and judicious imitation of good farmers, a man of mean talents, is sometimes known to make a tolerable figure in this line.—He may raise good crops; and good crops are no bad criterion of good farming. Indeed, a man, otherwise a blockhead, at least one who has no notion of first principles, often excels those who adhere to them with scrupulous exactness: but this must be only where the knowing man wants the talent of strict application. This talent is an essential requisite for a farmer; indeed it is indispensable in every occupation where success is desired.

The general principles, upon which the success of agriculture depends, are,

1. Without draining wet land, no improvement.

2. Unless land thus *drained*, is *properly cleaned*, the object of draining is frustrated, and that in proportion as this operation is executed.

3. Manures will always fail in producing the desired effect, in proportion as draining and cleaning are neglected.

4. Early sowing always produces shorter and stiffer straw than late sowing, and that in exact proportion to the times, when not affected by extraneous circumstances.

5. The various species of seed-corn are adapted to various soils, situations, seasons, and other circumstances.

5. Picking and propagating the best heads of the most approved kinds of grain and seeds, is the surest method of preserving them undegenerate.

Draining.—This article has been amply discussed by able hands, and Elkington's mode of draining is universally known. Almost every field has its own peculiar circumstances; and the general idea of intercepting the spring is an established principle in this art. But sometimes, when there is not sufficient descent to allow the drain to be cut as low as some deep sand or water gravel, where the springs lye, a few pits (to be afterwards filled with stones), or some holes by the boring irons, will have a surprising effect in raising the water into that drain, otherwise too ebb to reach the springs, and thereby carry it off. It is not my design, in this place, to enter into the minutiæ of draining, but to introduce it as a first principle in farming.

Without draining, no improvement.—Without it, no other operation can be effectual to the end proposed. When land is gorged with water, it cannot be cleaned. No labour is sufficient to do it, except in a very uncommon drought;—in some soils, not even then: and when land is not clean, it is impossible to suppose that dung, lime, or any other kind of manure, can have its full effect. Dung will promote the natural grasses more than any kind of grain which may be sown; and these, although the land is sown with artificial grass seed, will still thrive, and render the ground completely fit for a summer fallow immediately after dirty lea oats.

Cleaning.—This article requires the farmer's constant attention, and by this alone can be rendered effectual. Early ploughing is of much importance; and it is impossible to be too early at summer fallows, when spring sowing is over. As I at present speak chiefly of land in the second stage of improvement, it must not be considered so clean as in future it may be expected. We shall suppose the land of a free nature, but extremely dirty by means of its late moist state previously to draining; and that it has been capable of carrying one or two crops of oats, in order to reduce its surface sward; and is now under summer fallow. Every farmer may plough to his own mind, according to the nature of the soil, and the grass he has to destroy: but, in general, light ploughing is sufficient to kill grass, which generally runs near the surface; and then before the manure is applied, a strong furrow is of much use, to mix new earth with the dung. At same time, some soils will not admit of a strong furrow, unless in the spring, before the moisture is exhausted. In such situations, harrowing, rolling, and gathering grass roots frequently after every ploughing is essentially necessary; but it is not my design to teach either ploughing or harrowing.

Manures.—Neither is it my design to treat of the nature and properties of manures, and how they operate upon land, so as to produce better crops;—whether by communicating to the soil the vegetable food which they contain;—whether by enabling it to attract nourishment from the atmosphere,—or by enlarging the vegetable pasture which it contains,—or by dissolving that which the soil already contains, so as to prepare it for entering the roots of plants. These are philosophical inquiries, not essentially connected with the present business. Upon this subject, there are various theories, some of which are extremely rational, and others extremely absurd. Concerning the salts, which are an essential ingredient of dung, it is certain they cannot evaporate; but the oil and watery parts certainly will. We have a good illustration of this hypothesis, in the operation of the sun upon salt water. In warm climates, the sun exhales every thing from salt water, when exposed to its influence, except the

salt itself. In this way the inhabitants of such climes obtain that commodity. It is even gathered upon rocks, which the sea has abandoned after lodging a part of its water upon their exposed surfaces. But, when exposed in a more equal and regular manner, on an even surface, it is much sooner and more easily obtained.

When dung is carried to a field of summer fallow, and spread out green (as it ought to be),[b] till the act of fermentation has completely ceased, the oils must evaporate. But, as experience teaches us, that no material difference can be discerned between that which has been spread and that which has not, we must conclude, that the oils become fixed as soon as the dung dries; and that the essential qualities of the dung are thereby preserved, and ready to exert themselves as soon as mixed with the soil.

Early sowing produces less straw than late sowing, and that in exact proportion to the times (cæteris paribus).—The knowledge of this principle, which has not been discovered, at least not attended to, till within the last twenty years, is of much importance to the farmer.[c] Before it was known and practised, the hazards of sowing land in a very high state of cultivation was very great. Oats or barley sown in such condition, at the usual period of seed time as formerly, viz. oats, late in March, and barley about the term of Whitsunday, would have been often entirely ruined, by being too strong. English barley, (commonly from Lincolnshire) and Dutch and many other early kinds of oats, were adopted without changing the time of sowing: and as these have a tendency to produce shorter straw, they were found of much advantage in securing a full crop without lodging. But it is found that any of our oats sown early, produce a shorter and stiffer straw, which has the same effect. Early oats, however, are still much in vogue. The Lincoln barley is almost out of repute. It is well known to some farmers, that the common Scotch barley is the best substitute for it,—as, when sown early, its straw becomes shorter, much stiffer, and less apt to lodge. Potatoe oats are a new species introduced within these very few years; and are said to be natives of South America. It appears they were first im-

ported into some of our midland counties of Scotland, in a quantity extremely small; and that they obtained that name from the circumstances of their arriving in a *package of potatoes*. This is a valuable kind of oats in point of meal, yielding two to three pecks per boll more than the Angus, which, in every other respect, we reckon our best oats. They appear to be again losing ground in the estimation of some people. They are more apt than any other kind to keep the soil, like wild oats, and thereby to annoy the succeeding crops. It seems to be apprehended that, were they to be frequently shaken and ploughed in dry, that they would be as great a weed too. They seem to have another disadvantage, which, in the present circumstances of our labour, is not a small one. They ripen along with the wheat; and that article being now more than ever the chief object of the farmer, it is in danger of occasioning very serious consequences as to the timeous cutting of that crop. Potatoe oats are also extremely apt to shake, and seldom fail to drop in shearing. All kinds of early oats are fit only for fine land, or land in a high state of cultivation; but upon inferior land they are the best, when a bad season has thrown the seed time too far back for common ones. Blainsley oats are our native early, and have a finer meal as well as finer straw; but they seem mostly out of favour at present. These several varieties of oats and barley afford the farmer great advantages in securing his grass-seeds, as well as his corn crop, in certain seasons and situations.

As to spring wheat, the dwarf kind, which is known to produce short straw, and is an excellent flourishing kind, is also advantageous in the above circumstances; and as it has a natural tendency to produce short straw, it ought certainly, upon rich soils, to be preferred in winter.

Picking out the best heads of the most approved grain, is the best method of preserving the species from degenerating.[d] It must be evident to every one, that grain has a constant tendency to degenerate. But whether its species suffers or not, it must, by a thousand circumstances, be so blended and mixed with other kinds, and even with different grain, that it requires frequently

to be renewed by picking and propagating the best heads. This is found by experience to be the surest method of preserving the grain; and so different is the produce of the earliest and most vigorous ears from that of the poor diseased ones, that it has generally obtained some name to distinguish it from that even of its own kind. A farmer in East Lothian, (a Mr. Hunter) some years ago found, in a cold bleak situation (Coldingham muir), a very fine looking vigorous head of wheat; which, being ripe at a period earlier than might have been expected from its situation, he brought with him; and having repeatedly sown its produce, has at last furnished seed to a considerable part of that country, and even to farms in many a distant country. It is an excellent kind of wheat; being considerably earlier and more prolific than any kind we are yet acquainted with. Mr. Hunter has great merit, not only for his original attention to this article, but for the unremitting vigilance bestowed in preserving it free of mixture. It is now distinguished by the name of *Hunter's Wheat*.[c]

These hints, Mr. Conductor, may perhaps be of some use to farmers who are only about the beginning of their agricultural pursuits. They may cause a little reflection, and occasion rational experiments, which may confirm, in their mind, the utility of such first principles, upon which they were made.

REMARKS.

a Elkington's, or rather Anderson's mode of draining land, is very generally followed in England, and shall be described in the course of this work.

b It is not yet settled, whether dung produces better effects when ploughed in fresh, or completely rotten; or whether it is best when made into composts, and then applied to land. Much will depend upon the nature of the soil, the crop cultivated, and the seasons. This subject shall also be discussed hereafter. It has already engaged the theoretical, as well as practical attention of the editor. In the mean time, he will observe, that as it is very important, and as he has had much opportunity of knowing that stable manure is often so managed as not to produce half the good

effects that might result from it, if applied with judgment, every farmer will find it his interest to attend to the subject.

c No principle is better established, than the importance of early sowing of spring grain. The produce of such crops, is uniformly greater than those sown at a later period. Oats in particular are materially affected by it. Mr. Strickland, an English farming gentleman, who made a tour through the U. S. in 1794, has justly remarked* the uniform inferiority of our best oats to that of Britain, and the very bad quality of most of that grain in the U. S. In Scotland and Ireland very generally, and in many parts of England, thousands eat no other bread than that made from oat meal; and breakfast and sup upon a gruel made of the same invigorating and wholesome dish. Little of the American oats, would pay for conversion into meal. Our climate, from its warmth and dryness, is unfavourable to the filling of the grain, but the chief cause of its inferiority is the late time at which it is sown, in consequence of which, the grain has not time to fill; and the unprepared state of the ground from deficient ploughing. On both these points, some striking facts shall be given.

d The experience of that great improver Joseph Cooper, of New Jersey, on this head, it is presumed is familiar to most farmers in the United States. It was first made known to the British public, by a letter of the celebrated Priestly to Sir John Sinclair, in the first vol. of the Commun, to the Board of Agriculture, and has been extensively circulated by means of their numerous agricultural works. Most of the newspapers, almanacs, and periodical publications in the United States, have reprinted Mr. Cooper's own statement on that and other agricultural subjects, which ought to form part of the instruction of every country school.

e In a manner similiar to that pursued by Mr. Hunter, Mr. Isbel of Caroline county, Virginia, about 20 years since, brought into notice the early white wheat, the benefit of which has been amply experienced in Pennsylvania, particularly in low moist situations, subject to mildew. *Editor.*

* Commun. Board of Agric. Vol. 1.

ON THE

WHEAT MOTH, OR VIRGINIA FLY.

Tackoney, March 2, 1811.

SIR,

IT is about 45 years since the moth fly in the grain of wheat (perceptibly) visited the Eastern shore of Maryland, at which time I was a small boy; but remember it was early discovered there, that if the wheat was trodden out and fanned immediately after harvest, and laid up in bulk, a sweat soon commenced, which quickly destroyed the whole of the insects in embryo, except on the surface of the heap, which of necessity must be exposed to the air. This sweat is without doubt considerably heightened in consequence of the eggs contained in the grain; and as the heat soon exceeds the temperature of animal life, the destruction of the insects is accomplished; an effect that never fails even when the wheat is not laid up in bulk until the maggot has attained its full size; but in that case the sweating is prodigious, and rising to the top of the heap, forms a moldy crust several inches deep, in which the heat vegetates, and spreads a pile of foliage over the whole resembling a field, only vastly thicker set: yet under this crust, the grain becomes dry and perfectly free from all damage, except what had been sustained before it had been put into bulk. When trodden out, fanned, and put in bulk immediately after harvest, the injury either in weight or quality is imperceptible, but if left until a late period, it is scarcely fit even for the feeding of hogs, which have refused to eat it, when exceedingly damaged by the fly. I do not recollect either to have seen or heard of any bad consequences arising from eating bread made from the flour of fly-eaten wheat, but if the depredation in the grain has been considerable it has a very ill taste, and when cut into pieces, resembles boiled liver, and certainly cannot be wholesome; for I have known people who have been employed in the loading of ships with wheat eaten by the fly, to be covered from head to foot with small blisters as close as they could stand to each other: the itching occasioned by the dust from the wheat is intolerable,

even if the exposure has been inconsiderable. It is believed that this insect is propagated in the grain of the wheat while growing, consequently the precautions which have been frequently taken by Pennsylvania farmers, to grind the wheat in order to prevent further injury from the fly that has come out of the grain, is useless; for they are incapable of doing any further mischief until either they or their posterity puncture the grain of the ensuing crop. While it is growing, the eye easily traces the puncture through the hull into the pea, and no doubt with proper glasses, the same might be discovered through the chaff into the wheat.

Some years the ravages of those insects take a general spread through whole counties on the Eastern shore, but commonly their devastation has been partial, and it has sometimes happened, that while the grain on one farm, was almost entirely devoured when left in the straw, the adjoining farm had sustained but little injury from them. It is worthy of remark, that in order to effect the destruction of this insect with the least injury to the grain, the wheat should be placed in as complete a mass as possible, and no more surface exposed to the air than can be avoided; for if the wheat lies either thin or scattered, it is obvious that an effectual sweat will not be produced except in the deeper parts of it; and that where it lies thin it will be destroyed by the fly. It is a fact as well known and established on the Eastern shore of Maryland as any other fact, for it has occurred in numberless instances, that part of the same crops trodden out, fanned and put into bulk early, have been perfectly preserved, while the remainder which continued in the grain, has been either nearly destroyed, or rendered unfit for the making of bread.

Your friend and humble servant,

JOHN LORAIN.

James Mease, M. D.

REMARKS.

For several years past the wheat in the vicinity of Philadelphia has been greatly infested with the moth described by Mr. Lorain, and in some seasons little else than the husk of the grain has been left in crops, which when first cut, promised an abundant yield. The same insect infested the wheat in the province of Angoumois in France, for upwards of thirty years; and in 1755 those eminent agricultural philosophers, Duhamel and Tillet, were deputed by the Academy of Sciences at Paris, to inquire into the nature of the insect, and the means of preventing the calamity occasioned by it. Their description is very minute, and leaves no doubt as to its identity with the American insect. They found that threshing the grain as soon as possible after harvest, and kiln-drying what part was wanted for seed, or for grinding, effectually destroyed the eggs of the insect. When the grain is wanted for seed, care must be taken not to increase the heat beyond 124 degrees of Fahrenheit's thermometer, otherwise the vegetative principle of the grain would be destroyed.

This remedy of kiln-drying has been tried with success in our own country. Mr. Benjamin Mifflin relates,* that in 1776, when he removed from Pennsylvania to Kent county, Delaware, he found that the wheat moth had done immense mischief, and having read of the French process of kiln-drying the grain, he tried it upon some wheat which he bought for his annual supply, and in which the insect had even began to appear, with the most complete success. He heated the oven not quite hot enough to bake bread, but so hot as to permit him to bear his finger on the brick about ten seconds, and having filled it with wheat, closed the door for 24 hours. When taken out, he found the insect completely killed, and on being ground, the flour was not injured in colour, or capacity for rising, neither was the vegetative power of the seed destroyed. *Editor.*

* Bailey's United Magazine, Philadelphia, 1777.

ON DYEING TURKEY RED.

THE deficiency under which we labour respecting the art of dyeing, in the United States, has been already remarked. Every fact therefore, on the subject, is highly important, and should be carefully attended to. The following paper on dyeing cotton red, is a valuable addition to our stock of knowledge in the art, and is particularly gratifying to the Editor, from having introduced the process into the American edition of the Domestic Encyclopædia. He can bear witness to the excellence of the dye, having seen it in the clothes worn by Mr. W.—Happy the country gentleman, whose wife is occupied in such pursuits!

From the Republican Constellation, [Winchester, Virginia.]

MR. FOSTER,

MRS. WASHINGTON made attempt last summer to dye cotton to the colour generally known by the name of Turkey Red. She followed a receipt contained in the Domestic Encyclopædia, and succeeded beyond her expectations, in imparting to the cotton yarn a beautiful, brilliant red colour, possessing a permanence that was at first little expected. She had the yarn woven into a piece of fancy cloth, for her own wear, which has been very often washed, and still retains its brilliancy of colour, without any sensible diminution.

Several persons have admired the colour, and expressed a great desire to get the receipt. As the Domestic Encyclopædia is in comparatively few hands, and the season for dyeing and making cotton cloth is approaching, I have thought it would be rendering some service to condense the receipt into familiar language, and to publish it in both the Winchester papers for general benefit. In the original it is very long, and a great many technical terms are used, which I have avoided as much as possible.

The Domestic Encyclopædia contains many other receipts for dyeing, bleaching, distilling, making of soap, &c. And upon all subjects of domestic economy, contains the greatest number of valuable facts and directions of any book extant of its size, and ought, in my opinion, to be in the possession, or within the reach, of every farmer and mechanic of our country.

By giving this a place in your next paper, you will oblige yours, &c. LAU. A. WASHINGTON.

PROCESS.

First—Make a ley of one part of good potash, dissolved in four parts of boiling water. Then slack half a part of lime in it. Next dissolve one part of powdered alum, in two parts boiling water, and while this last solution is warm, pour the ley gradually into it, stirring and mixing them close together. Then add to the above mixture, a thirty-third part of linseed oil, which, when well mixed with it, will form a rich milky substance, resembling cream. As the skeins of cotton are dipt into this mixture, it must be stirred, as the oil will rise to the top of it when it is at rest.

The above ingredients make what is chemically called, 'Alkaline solution of alumine, mixed with oil;' which, in speaking of hereafter, I shall call the *alkaline mixture.*

The quantity of the alkaline mixture to be made, must be determined by the quantity of cotton intended to be dyed. And to ascertain the respective parts of the different ingredients as named above, they must all be weighed; beginning with the water first, of which there must be enough to permit each skein of cotton to be entirely immersed in it.

Before the cotton (or flaxen thread, when that is to be dyed) is dipt into the alkaline mixture, it must be first well bleached and cleaned by washing, of every foreign, extraneous substance. Then boiled in strong ley made of potash, and dipt into the alkaline mixture whilst it is hot, and as wet as it will be when the ley is well gotten out of it by drawing the skeins through the hands. The skeins are to be immersed into the alkaline mixture, one after another, and to be repeatedly dipt and drawn gently through the hand until they become well soaked. As each skein undergoes the above process it is to be put upon a pole, in the shade, to dry; in summer they are to be put out of doors where they are protected from the rain, and in the winter to be kept in a warm place, within doors. After remaining in that state for twenty four hours, they must be well washed in pure running or rain water and again dried.—After which they are to be washed in a strong ley, made of good hickory ashes (or better of potash) one skein after

another, and gently and equally pressed, by drawing through the hand or a pair of smooth wooden rollers and again hung up to dry.

The madder is now to be used—after fixing upon the quantity (which will be regulated by the deepness of the colour intended to be produced, of which more will be said presently) it must be put in as much clean rain water, as will completely and entirely cover the whole of the cotton. Then add thereto of pounded chalk (which must by no means be omitted) a fourth of the wt. of the madder used. It must now be put over a slow fire, and kept for about three hours, at a state of heat, something less than boiling, or in such a state that hardy persons can put their hands into it without being scalded. During this part of the process, the skeins are to be frequently shifted and changed, that every part of them may imbibe the colouring matter. From this the cotton is taken and dried, and then washed in a large quantity of water to cleanse it. The finishing part of the process, called clearing, now follows, which consists in boiling the cotton for eight hours in water, containing a bag filled with bran. The water is to be kept in a brisk state of boiling the whole time, and as it evaporates, boiling water is to be added. The water ought also to be boiling, when the cotton is put into it. The deepness or intensity of the colour, in this mode of dyeing, will be regulated by the number of times the cotton is dipt into the alkaline mixture and the quantity of madder used. To give the different shades of red, the cotton may receive two, three, or four immersions, and a quantity of madder equal to once, twice, three, or four times the weight of the cotton. If dipt more than once, fresh alkaline mixture must be made each time, as it loses its qualities by standing. And the same process of drying, washing in water and ley, as above described, must be observed and strictly attended to after each dipping into the alkaline mixture.

Wool and silk, which are animal substances, imbibe different colours more freely than the vegetable substances cotton, hemp or flax. It has therefore been found necessary that cotton and flaxen thread should be *prepared* in a particular manner, before they will receive and retain the colouring matter of dye stuff.—

The articles which are used to give them this *necessary preparation*, are called "Mordants," and act as a kind of bond of union, between the substance intended to be dyed and the colouring matter. Thus the above alkaline mixture, is a mordant which prepares either cotton or flaxen thread or cloth, to receive not only the colour of the madder, but of any other dye stuff you choose to use, as cochineal, Brazil wood, quercitron or black oak bark, log wood, &c. &c. and gives a brilliancy and permanence to the colours of different dyes, which cannot be produced without that or some other mordant.

When flaxen thread is intended to be dyed, the same process in all its parts must be used as above described for cotton.

L. A. W.

MEMOIR ON THE MORDANTS EMPLOYED IN DYEING.*

By Messrs. Thenard and Roard.

Read to the class of Physical and Mathematical Sciences of the Institute.

Translated for the "Archives."

MORDANTS are those substances which serve to effect a perfect combination of the colouring matter with stuffs, and that increase their beauty. Those properties are possessed by a great many saline and metallic substances; but those that possess them in the greatest degree, and which, for that reason, are preferred by all workmen, are alum, acetate of alumine, tartar, and solutions of tin.

The examination and analysis of the effects produced by these mordants, upon the animal and vegetable substances, shall be the subject of our present investigation.

We shall divide the subject into four chapters, in which we will make known successively, the action of alum, the acetate of alumine, of alum and of tartar, and of the solutions of tin upon silk, wool, cotton and thread, agreeably to the methods most commonly employed in dyeing.

* From Annales de Chimie. June 1810.

CHAPTER THE FIRST.

ON ALUM.

The manner of using alum, which is called "alunage," (aluming) varies according to the nature of the stuffs, and to the colours that are desired. Silk is left to macerate for some days in the solution of alum sufficiently strong to prevent the chrystallization of the salt. Aluming wool is effected by boiling it for two hours in water, with a fourth of its weight of alum. Cotton and flax thread are alumed with a strong solution of alum in luke warm water, to which potash is often added, and in which it remains at least for 24 hours. It has hitherto been thought, that in this operation, alum was decomposed, and that alumine was combined with the stuff, the colour of which was more easily fixed, when dipped in the dyeing liquid: but the experiments which have been made, force us to reject this opinion.

ARTICLE I.

Analysis of Alumed Silk.

Ninety-five grammes* of silk well cleansed, and perfectly purified, having been put into a glass vessel, for the space of six days, at the temperature of the atmosphere, with four litres† of distilled water, and 100 grammes of pure alum, which had been previously dissolved in a complete manner. After this time, the silk being taken out of the liquid, was hung up to be entirely dry, over the alum bath, and washed several times with distilled water, to separate the part of the mordant which had not been combined with it. The alum bath and the washings, were evaporated with much care, and they gave often, and even to the end, very transparent chrystals of alum. These first results show us, in a positive manner, the nature of the combination formed with the

* A gramme is the French unit for weight, equal to 15.4457 English grains Troy. *Editor.*

† A litre is the French standard measure of capacity, and equal to 61.02800 English cubic inches, or about 1, 5-7th of a pint, ale measure. *Editor.*

silk, during the aluming, and that it was at the same time very probable, that the alum had not been decomposed. We again boiled that alumed silk in a mattrass, with six litres of distilled water; after having let off the boiling water, we washed it twelve times; the 72 litres arising from these twelve operations, having been evaporated, gave us again well defined chrystals of alum, which quantity added to that from the alum bath, did not differ more than two decigramme, or $\frac{1}{420}$ part from the 95 grammes which had been employed. If after each of these twelve washings, you try to dye silk, the colour becomes less and less deep, so that after the twelfth washing, the silk becomes incapable of being died. The silk being disalumed, or deprived of alum, and again alumed, acquires immediately the quality of fixing the colours as strong as before any washing. From which results, the natural explanation of the cause why the alumed silks take colour more intensely, when they are dyed at a low temperature, than when they are plunged at once into boiling water.—The reason is, that in the first case, the action of the boiling water on the mordants is so quick, that the colouring matter has not time to be fixed in it, in in order to give insolubility to the combination; but in the second case, this effect cannot take place.

ARTICLE II.

Analysis of Alumed Wool.

After having determined the phenomena, that take place in the aluming of silk, it became necessary to continue the examination in the case of wool, and to only employ matters perfectly pure, and especially free from carbonate of lime, which is always in a pretty strong proportion. To separate it from them, we boiled them several times in a mattress, with very weak muriatic acid, but in order to extract the last portion of the acid, it was necessary to use so considerable a quantity of distilled water, that we were ready to abandon the experiment, which required, besides time and patience, the greatest care. The separation of the muriatic acid from the two first hecto grammes of wool, which we had purified, required 200 litres of distilled water, the temperature

of 100 degress of the centigrade thermometer,* and being divided into 20 successive operations, every one lasted from seven to eight hours. Calcined and treated properly, the lime and muriatic acid disappeared totally. One hundred grammes of this wool, have been alumed with the same caution that was employed in the case of silk. Afterwards it was submitted to 20 washings, at the temperature of 100 degrees of the centigrade thermometer, in a mattress, with 6 litres of distilled water for each operation. The aluming being finished, this wool took colours the most intense, while after the last washing, it could not receive a colour from the dye, more than the same white wool that had not received any mordant. These comparative experiments show us, that the substance which had been fixed by the aluming, and which at first had determined the colouring of the wool during the dying, had been removed by the water. The alum bath evaporated, gave in the state of chrystals two thirds of the quantity of alum which had been employed: We found almost entirely, the other third in the residue of the bath, chrystalizable with difficulty, and in the produce of the washing of the alumed wool. We repeated these experiments several times, and constantly with the same results; but as they did not appear to us as sure as that on silk, on account of the difficulty of separating the animal matters from the last part of the alum bath; we alumed the wool in the cold, as we had done the silk, persuaded, that in that case, the bath could not sensibly dissolve that matter.

We alumed in the cold, in a solution of alum of 5°. some pure wool, and we have taken out during the operation on the silk, either from the alum bath, or the washings, except about $\frac{1}{400}$ part, all the alum which had been used. As we were certain, that in the aluming of all these animal matters, the alum is entirely combined with them, without undergoing any decomposition, and that it then forms combinations, more or less soluble, which have a great affinity for the colouring matter.

* Or Thermom. of Celsius, the zero is placed at the freezing point, and divides the range between it and the boiling point of 100 °.—*Editor.*

ARTICLE III.

Analysis of the Aluming of Cotton and Thread.

After having extracted from a parcel of cotton, by the foregoing means, all the foreign matters combined with it, we alumed it in a luke warm bath, with a certain quantity of alum, and let it macerate therein two days. After that operation, this stuff dyed perfectly well, but treated afterwards at 100° of the centigrade thermometer in a mattress, with distilled water, it lost the property of being coloured in the dye vat. The alum bath, and the washings being evaporated, gave us the same quantity of alum, that had been used. We succeeded in separating the alum from the vegetable matter, which it had dissolved by several chrystalizations. We did not wish in this operation, to wash the cotton as often as we did the silk and wool, seeing that the union of the alum with vegetable substances is so weak, that we cannot immerse during some minutes, the alumed cottons in boiling water, without depriving them of a great part of their mordant. So, *for cotton stuffs, the greatest care is to be taken to dye them at a low temperature, because it is only when the colouring matter has given a degree of insolubility to that union, that it can, without being altered, support a great heat.*

A parcel of thread, treated in the same manner, gave the same result.

ARTICLE IV.

Analysis of the Aluming of common Wool.

Our analyses have shown in the fullest manner, that in the aluming of animal and vegetable substances, the alum was combined with them, without any decomposition, but we thought it necessary to verify also, on the substances, in their ordinary state, the facts which they offered to us after being purified. The wools alumed with alum alone, always render the bath very muddy, and let fall when cold, a great quantity of white precipitate, as several chemists have observed. These precipitates, being well washed, have constantly furnished us sulphate of lime, saturated

sulphate, and sometimes a little alumine. The bath was composed of a considerable quantity of alum, of acidulous sulphate of potash, combined with a small proportion of animal matter. We only found on the wool some alum, and a very small quantity of precipitate.

These experiments on the precipitates formed by the aluming, do not differ from those of Mr. Berthollet, but that learned chemist having neither examined the mother waters, nor the alumed wools, could not give, as he himself acknowledges, a clear explanation of the effects produced by the alum and the tartar in the operation of dyeing. These precipitates obtained by the common wool with alum, never occur in purified wool; and as those matters do not differ among themselves except by the presence of the carbonate, it was natural in such a case, to attribute to that substance the decomposition of a part of the alum.

We ascertained ourselves in treating during many hours at the temperature of 100°, in a glass vase, some solutions of alum in distilled water, with different proportions of carbonate of lime. We have acknowledged, that the alum was decomposed by the carbonate of lime; and that if you had a sufficient quantity of it, there would not remain the smallest particle of the alum salt in solution. The mother waters are the very acid sulphate of potash, and the precipitates are formed of the sulphate of lime, and the acidulous sulphate of alumine, and of potash: from which it follows, that the property possessed by ordinary wools, of forming a precipitate in the alum bath, and causing a great degree of acidity therein, proceeds really from the carbonate of lime. We obtain moreover a result precisely similar, in making with ordinary wool, five or six successive alumings with the same bath. But to come to a general solution of the question, it was necessary to ascertain the nature of the precipitate formed in the solutions of alum, by means of several alkaline and earthy substances. We have taken then, alums with base of potash, and base of ammonia, which we treated with ammonia and carbonate of potash, in such a manner, as to have in their solutions a small excess of alum. The mother waters evaporated, were very acid sulphate of ammonia, of potash

and ammonia, and of potash, according to the nature of the alum, and the precipitant employed. The precipitates, which were acidulous sulphate of alumine and of potash or ammonia, treated by the sulphuric acid, gave some alum, and acidulous sulphate of alumine; boiled moreover a number of times with distilled water, they were changed into alum, into sulphate of potash, and into pure alum : but more of the acid sulphate of potash, than of alum.

The solutions of alum, brought to 100 degrees of heat on the centigrade scale, with pure alumine, were converted into very acid sulphate of potash, and acidulous sulphate of alumine and potash. After this, we could have no doubt as to the alterations produced by the common wool in the alumed baths, and upon the inconvenience of alkalies in those destined for cotton ; for the addition of those matters diminish the quantity of alum, and even increases the acidity of the bath.

(Remainder of this article in our next.)

SALE OF ENGLISH CATTLE.

IN page 49, Vol. 1. of the Archives, it was stated, " that in England, where the attention of numerous persons has been successively directed to the improvement of every species of domestic animals, for upwards of the last fifty years, it is acknowledged by the best authorities, even at the present day, that good cattle are extremely scarce, and of course command very high prices." The celebrated sale of Mr. Fowler's stock of Little Rollright, in the county of Oxford, England, in the year 1793, has often been quoted as an extraordinary instance of the value put upon improved farm stock, and as a proof of the spirit which had been excited among the agriculturalists of England. The prices then given, although high, are small when compared with those given for some animals at a sale on the 11th October 1810, of the stock of a celebrated improver, Charles Collins, of Ketton, near Darlington. The following are the particulars taken from a recent English publication.

The farm does not exceed 300 acres, and the total produce of cattle and sheep 3485£. The price at which the cattle were disposed of, were as follows:—

Bulls.—Comet, 6 years old, sold for 1000 guineas, purchased by four eminent gentlemen farmers and breeders on the banks of the Tees: Petrarch, 2 years old, sold for 365 guineas: Major, 3 years old, 200 guineas: May Duke, 3 years old, 145 guineas: Alfred, one year old, sold for 110 guineas: Duke, one year old, 105 guineas: five others of inferior note, from 50 to 76 guineas each. *Bull calves.*—Cecil sold for 170 guineas: Young Favourite 140 do.: George120 do.: one 20 do. one 60 do. one 50 do. one 15 do.

Cows.—Lilly, three years old, sold for 410 guineas: Countess, nine years old, sold for 400 do.: Laura, four years old 210 do.: Lady, fourteen years old, 206 do.: Celina, five years old, 200 do.: Peeress, five years old, 170 do.: Magdalen, 170 do.: Cathaline, eight years old, 150: Daisy, six years old, 140: Johanna, four years old, 130: Beauty, 120 do. Five others, from 45 to 83 guineas. *Heifers.*—Young Countess, two years old, 206 guineas: Duchess 183: Chàriotte, 136: Lucy, 132 do. Young Laura, two years old, 101 do.: Shock, three years old, 105 do.: Johanna, one year old, 35 do. *Heifer Calves*: one 106 guineas: one 75 do.: two for 50 do. each: one for 25 do.

The foregoing stock was of the Teeswater breed, a bull of which breed was figured in the last number of the Archives.

CATTLE SHOW.

THE fifth show, held under the direction of "the Society for improving the breed of cattle in Pennsylvania," took place at the tavern lately kept by Peter Evans, at the west end of High-street, near the Schuylkill, on the 16th April last. The number of cattle was smaller than usual.

Mr. Niglee showed several fat and well formed cattle, which had been purchased last year at Bushhill.

Mr. Wynkoop of Bucks county, showed a very large steer, four years old.

Mr. Dubbs showed two hogs, one of which weighed 672 lbs. the other 563 lbs.

The society, from a conviction of the utility of the measure, intend to continue the shows, every spring and autumn. The next one will be at Bushhill, of which place the society have taken a lease. Early notice will be given of the precise time at which the show will be held.

A hog recently killed, that was raised by Isaac Wheaton, of Hopewell township, Cumberland county, N. Jersey, measured and weighed as follows :

	Ft.	In.
From end of nose to root of tail, - -	8	—
Round the body, - - -	7	4
Height, - - - -	3	10

	Cwt.	*qr.*	*lb.*
Live weight, - -	86	1	16
Fat of entrails, - -			26

During the winter of 1808—9, four hogs were shown in Philadelphia, which had been raised and fed by Ellis Wright, of Burlington, N. Jersey; one of them weighed 900 lbs. another nearly the same weight—a third weighed less, and the smallest weighed 775 lbs. They were three years old; the sow was of the African or Guinea breed.

The ninth premium proposed by the Cattle Society of Pennsylvania, has been recently gained by Mr. Wm. Carpenter of Salem, N. Jersey, the amount of which has been presented, agreeably to his desire, in a superb goblet of antique form, made to order by Chaudron,—and bearing an inscription of the reasons for its presentation. The terms of the premium were,

"To the person who shall raise and feed ox, steer, or cow, whose weight of neat beef, shall be at least 1500 lbs. and have 300 lbs. of rough tallow : one hundred dollars."

The weights of Mr. Carpenter's ox were as follow :—(They

were taken in the presence of the clerk of the market, and a member of the society.)

Beef,	- -	1668½ lbs.
Tallow,	- -	340
Hide,	- -	147

He was eight years old; and killed by Tallman and Miller of Philadelphia.—Will any one have the hardihood to assert, after the foregoing examples, and those given in the last number of the Archives, that "Nature is belittled in the new world?"

FRUIT TREES.

Every fact on the subject of fruit trees, is so important, especially when connected with the subject of destroying insects, the increase of which, in the United States, is cause for much alarm, that the editor does not hesitate to give insertion to the following short paper from the "Connecticut Courant." He begs his correspondents, and the readers of the Archives, to try the experiment, and to acquaint him with the result. The remarks may be compared with those of a similar nature in the last No. of this work.

TO DESTROY CATTERPILLARS.

AS the season is arrived for the insects which produce the canker worm, to quit their wintry abode, and ascend to the apple trees, it may not be amiss to publish a few observations and experiments on the subject.

A neighbour of mine observed an article in the papers of the last year, advising to enclose the trunks of the trees with a narrow bag made with linen cloth filled with fine salt; but he not having any cloth suitable for the purpose, used as a substitute what the farmers call swingling tow, which he twisted into a large string, and long enough to go round the body of the tree, putting in salt as he twisted it up, so as to enclose the tree with salt, about two feet from the ground—This tree was loaded with fruit in the fall of the year, while the other trees in the orchard appeared as if a fire had passed through them; which experiment I

think goes far to establish the fact, that the salt used in either way, will preserve trees from the ravages of the canker worm.

The catterpillar or bag worm, I am confident, may be prevented from injuring the fruit of the apple tree, by placing a turf in the crotch of the tree. I tried it in a number of trees in my orchard the last season, and there were none of the worms to be seen on them through the summer; but one tree which I neglected, I found when the worms were about half grown, was like to be injured by that destructive insect; I then destroyed as many of them as I conveniently could, and applied the turf, and in a few days there was not one to be seen on the tree.

Another neighbour of mine informed me, that he has a couple of plumb trees in his garden standing some distance from each other; in the summer he found that one of them was covered with bag worms, and recollecting the advertisement which recommended the use of the turf, he applied one to the infected tree, and the consequence was, that they all left that tree and took to the other.

ON RAISING FRUIT TREES BY ABSCISSION.

The following very singular and interesting account of the process is related by Dr. J. Howison, in the 25th vol. of the Trans. Soc. Arts. London.

THE Chinese, in place of raising fruit trees from seeds or from grafts, as is the custom in Europe, have adopted the following method of increasing them.

They select a tree of that species which they wish to propagate, and fix upon such a branch as will least hurt or disfigure the tree by its removal.

Round this branch, and as near as they can conveniently to its junction with the trunk, they wind a rope, made of straw, besmeared with cow dung, until a ball is formed, five or six times the diameter of the branch. This is intended as a bed into which the young roots may shoot. Having performed this part of the operation, they immediately under the ball divide the bark down

to the wood for nearly two-thirds of the circumference of the branch. A cocoa-nut shell or small pot is then hung over the ball, with a hole in its bottom, so small that water put therein will only fall in drops; by this the rope is constantly kept moist, a circumstance necessary to the easy admission of the young roots, and to the supply of nourishment to the branch from this new channel. [A gourd would answer instead of a cocoa nut.]

During three succeeding weeks, nothing further is required, except supplying the vessels with water. At the expiration of that period one-third of the bark is cut, and the former incision is carried considerably deeper into the wood, as by this time it is expected that some roots have struck into the rope, and are giving their assistance in support of the branch.

After a similar period the same operation is repeated, and in about two months from the commencement of the process, the roots may generally be seen intersecting each other on the surface of the ball, which is a sign that they are sufficiently advanced to admit of the separation of the branch from the tree. This is best done by sawing it off at the incision, care being taken that the rope, which by this time is nearly rotten, is not shaken off by the motion. The branch is then planted as a young tree.

It appears probable, that to succeed with this operation in Europe, a longer period would be necessary, vegetation being much slower in Europe than in India, the chief field of my experiments. I am, however, of opinion, from some trials which I have lately made on cherry trees, that an additional month would be adequate to make up for the deficiency of climate.

The advantages to be derived from this method are, that a further growth of three or four years is sufficient, when the branches are of any considerable size, to bring them to their full bearing state, whereas, even in India, eight or ten years are necessary with most kinds of fruit trees, if raised from the seed.

When at Prince of Wales's Island, I had an opportunity of seeing this proved by experiment. Some orange trees had been raised by a gentleman from seeds sown in 1786, which had not borne fruit in 1795, while branches taken off by the Chinese mode in 1791, had produced two plentiful crops.

Whether forest trees might be propagated in Europe in the same manner, I have not had experience sufficient to form a judgment: if it should be found practicable, the advantages from it would be great, as the infancy of trees would, by this means, be done away, a period, which from the slowness of their growth, and the accidents to which they are liable, is the most discouraging to planters.

The adoption of this method will, at all events, be of great use in multiplying such plants as are natives of warmer climates, the seeds of which do not arrive here at sufficient maturity to render them prolific.

I have frequently remarked that such branches of fruit trees as were under the operation of abscission, during the time of bearing, were more laden with fruit than any other part of the tree. It appeared to me probable, that this arose from a plethora or fulness, occasioned by the communication between the trunk and branches, through the descending vessels being cut off by the division of the bark, while that by the ligneous circles or ascending vessels, being deeper seated, remain.* The same reasoning accounts for fruit trees producing a greater crop than usual, on being stripped of their leaves, most of the ascending juices being thrown off by them in perspiration, or expended in their nourishment; as we see that bleeding trees cease to give out their juices after they have put forth their leaves.†

I have observed that the roots from a branch under the operation of abscission, were uniformly much longer in shooting into the rope when the tree was in leaf, than the contrary; hence, the spring season appears most proper for performing that operation.

* The circumstances attending the Chinese method of propagating fruit trees, appear a strong confirmation of Mr. Bonnet's opinion, that plants as well as animals have a regular circulation of their fluids.

† Marsden, in his History of Sumatra, page 119, says, "The natives, when they would force a tree that is backward to produce fruit, strip it of its leaves, by which means its nutritive juices are reserved for that important use, and the blossoms soon show themselves in abundance."

It will seem singular that the Chinese entertain the same opinion that Linnæus did, respecting the pith of trees being essential to the formation of seed. By cutting into the trunk of the guava tree before it has produced, and making a division in the pith, they have obtained fruit without seed.

I am Sir,
Your obedient Servant,
JAMES HOWISON.

London, June 4, 1806.

LAW DECISION,

IMPORTANT TO MANUFACTURERS.

Munns, vs. *Dupont De Nemours, & Co.*

IN the circuit court of the United States, sitting at Philadelphia, before judges Washington and Peters, and a special jury. Monday 6th May.

This was a cause of great interest and expectation. It was an action for a malicious prosecution, wherein the plaintiff laid his damages at one hundred thousand dollars: 1st, For having charged the plaintiff before Mr. Alderman Keppele, in Philadelphia, with having stolen a brass pounder and three drafts of machinery, and with thereupon having the plaintiff imprisoned. 2d, For bringing a civil action against the plaintiff, and demanding excessive bail. 3d, With having caused the plaintiff to be indicted in Delaware as the receiver of five pieces of parchment seives, knowing them to have been stolen—all charged to have been done maliciously, and without probable cause.

The case was conducted for the plaintiff by Mr. Browne, Mr. Hopkinson, and Mr. Rawle; and by Mr. Charles J. Ingersoll, Mr. Binney, and Mr. Ingersoll, for the defendant.

The evidence was voluminous, and as it is very clearly set forth in judge Washington's charge to the jury, we forbear attempting an outline of it.

JUDGE WASHINGTON'S CHARGE.

Gentlemen of the jury—The plaintiff having some skill in the mystery of making gun powder, engaged with Brown, Page and company, of Virginia, in November 1808, to superintend the manufactory of that article, which they were about to establish near to Richmond; and with a view to obtain more complete information of the art than he then possessed, or to procure workmen, or certain parts of machinery, he came to the northward early in December. On the 9th, he put up at an Inn called the Buck, within half a mile, or thereabouts, of the powder manufactory of the defendant's, on the Brandywine, about four or five miles from Wilmington, in Delaware. The powder of this factory had obtained great celebrity, and commanded the market, in consequence of the skill employed in making it, and probably from the use of certain parts of the machinery employed, particularly certain parchment seives. The plaintiff, immediately after his arrival at the Buck, opened a correspondence with some of the defendant's workmen, and had frequent interviews with them at the tavern, at which he made them considerable offers to induce them to leave the service of the defendants, and go to the manufactory at Richmond. He also made them pecuniary offers to procure for him patterns or models of the different parts of the machinery used by the defendants, and particularly to procure him a sight of one of the brass pounders, or a pattern of it.

The defendants, hearing of the plaintiff's conduct, called upon him at the tavern, and after offering considerable violence to his person ordered him to quit the neighbourhood, which he did on the 14th. It is proper to remark that great pains were taken by the defendants to preserve the secrets of their art, and that strangers were not, without leave, admitted into their factory. Shortly after the plaintiff had left this neighbourhood, two of the defendant's workmen secretly went off, and at the same time one of the brass pounders was missing. The plaintiff came to Philadelphia, and a few days afterwards, the defendants also came to this city. On the 22d December they applied to alderman Keppele for the warrant stated in the first count of the declaration, and on their

oath valued the property charged to have been stolen at $10,000. The officer to whom the warrant was delivered, met with the plaintiff the next day, and enquired of him if his name was not Munns.—The plaintiff denied it, and assumed a fictitious name. The officer, however, being satisfied that he answered the description, carried him to the house of the high constable, where he acknowledged himself, and after he was informed of the nature of the charge against him, he put to the officer this question, "If I was in the company of one who had stolen certain articles, am I guilty?" The officer declined giving an answer, and conducted the prisoner to the office of Mr. Keppele. There he was examined, and by order of the alderman, his person was searched, when certain letters were found in his pocket book, from him to Brown, Page & Co. and from them to him, by which it appeared, that the plaintiff, previous to his arrest, knew that the defendants were in Philadelphia, and suspected they were following his steps —that he had obtained all the information he wanted to enable the Richmond to equal the Brandywine powder manufactory— and that some of the hands belonging to the defendants had left them and gone to Richmond.

The alderman committed the plaintiff to the jail of Philadelphia, having required bail to the amount of $15,000, which the plaintiff could not give. On the 27th the plaintiff was carried before judge Rush, on a habeas corpus, who reduced the bail to $1,000; but this he could not get, and was again committed. On the 29th, the defendants sued out the writ mentioned in the second count, for seducing the defendants' workmen and servants, demanding bail in $6,000, which on citation before judge Rush, was reduced to $600.

The defendants having obtained from the governor of Delaware a requisition on the governor of Pennsylvania, for the plaintiff's removal to the former state, as a fugitive from justice, he was accordingly removed on the 6th Jan. 1809, to the jail at New Castle. On the plaintiff's removal to Delaware, the defendants discontinued their civil suit in Pennsylvania, and renewed it in Delaware, laying their damages at $2000. On the 4th February,

the plaintiff on a habeas corpus obtained from the chief justice of Delaware, was discharged from confinement on the criminal charge, upon the ground that he ought to have been committed under a warant from some magistrate of that state, and not under the warrant of the governor of Pennsylvania, which authorized only his removal from the one state to the other: but he was remanded by the chief justice of Delaware, to answer in the bail of $2,000 to the civil action. Thinking now to correct this error, the defendants obtained a second warrant against the plaintiff from a justice of the peace of Delaware, charging him with a suspicion of having stolen a brass stamper and sundry other articles, of the value of $40, or of having caused them to be stolen. It is admitted that the stamper is the same instrument with the pounder, mentioned in the warrant issued by Mr. Keppele. On the 11th March, the plaintiff was discharged upon a habeas corpus, on the ground that by the law of Delaware no person could be committed by a judge or justice, who has once been discharged upon a habeas corpus from confinement on account of the same offence. In May a bill was sent to the grand jury charging the plaintiff as the receiver of four pieces of parchment seive, the property of the defendants, knowing them to have been stolen. The jury found the bill, the trial was postponed, on the plaintiff's application, till the following December, the plaintiff remaining in jail till October, and finally on his trial he was found not guilty by the petit jury. The attorney general then moved the court to certify probable cause, in order to compel Munns to pay the costs of the prosecution, agreeably to the constitution of Delaware; but the counsel of Munns agreed that his client should pay the costs, if the court would not grant the certificate, in consequence of which, the certificate was not granted.

The remainder of the evidence, except such parts of it as will be more particularly noticed hereafter, relates to the plaintiff's sufferings, which it must be acknowledged were very great. But as to these, it is to be observed, that except where they were produced by the immediate agency or interference of the defen-

dants,* no inference of malice can be drawn from these sufferings to charge the defendants, although they may be considered in estimating the damages, if the plaintiff has made out such a case as to entitled him to a verdict for any thing. For the assault and battery at the Buck tavern, the defendants have been indicted and punished by a fine of fifteen dollars each, and therefore that transaction is no otherwise to have influence on your minds than as it may become an item in the account of malice, charged upon the defendants. So to the high value affixed to the articles charged to have been stolen, in the Philadelphia warrant, and the low value affixed to the same articles in the Delaware warrant, and the amount of the damages claimed in the civil suit brought in Pennsylvania, are only to be considered in relation to the question of malice.

The question then is, are the defendants liable for damages on account of the warrant issued by Mr. Keppele, and the consequent confinement of the plaintiff—and secondly, are they liable in consequence of the indictment in Delaware, and the injuries to which it exposed the plaintiff?

The question upon which this case must be decided, is not, whether the plaintiff has suffered from a charge of which the defendants were the authors, and which in point of fact, was not founded in truth, but whether the charge was made maliciously, and without probable cause. In trials of actions of this nature, it is of infinite importance to mark with precision, the line to

* Nothing was proved in course of evidence, to justify the charge of malice on the part of the defendants; on the contrary, much appeared to show that a public example, was all that they looked to, or wished for. The officer who took Munns from Philadelphia to Delaware, had him hand-cuffed, because a dirk had been found upon him; when the defendants saw him thus confined, they had him freed from his shackles: at New Castle, by order of, and at the defendants expence, he dined at the table of the jailor, until it was found that he could afford to pay for his own fare. They felt resentment, as any man would do, at whose manufactory a death blow was aimed; and except in the first instance of the severe drubbing which Munns received, and which few men would have refrained from bestowing if they had the ability, (and for which they were fined,) all their measures were sanctioned by law. *Editor.*

which the law will justify defendants in going, and will punish them if they transcend. On the one hand, public justice and public security require that offenders against the laws should be brought to trial, and to punishment, if their guilt be established. Courts and jurors, and the law officers, whose duty it is to conduct prosecutions against public offenders, must in most instances, if not in all, proceed upon the information of individuals, and if these actions for malicious prosecutions are too much encouraged, if the informer acts upon his own responsibility, and is bound to make good his charge at all events, under the penalty of responding in damages to the accused, few will be bold enough, at so great a risk, to endeavour to promote the public good. The informer can seldom have a full view of the whole ground, and must expect to be frequently disappointed by evidence which the accused alone can furnish. Even when possessed of the whole evidence, he may err in judgment, and in many instances, a jury may acquit, where to his mind the proofs of guilt were complete. It is not always the fate of those to command success, who deserve it. On the other hand, the rights of individuals are not to be lightly sported with, and he who invades them, ought to take care that he acts from pure motives, and with reasonable caution. For the integrity of his own conduct he must be responsible, and his sincerity must be judged of by others from the circumstances under which he acted. If, without probable cause, he has inculpated another, and subjected him to injury in his person, character or estate; it is fair to suspect the purity of his motives, and the jury are warranted in presuming malice. But though the malice should be proved, yet if the ascusation appear to have been founded upon probable ground of suspicion, the accuser is excused by the law. Both must be established against him—malice and the want of probable cause. Of the former, the jury are exclusively judges. The latter is a mixt question of fact and law: what circumstances are sufficient to prove a probable cause must be judged of and decided by the court. But to the jury it must be referred to say whether the circumstances which amount to probable cause, are proved by credible testimony.

What then is the meaning of the terms 'probable cause?' I answer, a reasonable ground of suspicion, supported by circumstances sufficiently strong in themselves to warrant the belief that the person accused is guilty of the offence with which he is charged. What then were the grounds of suspicion upon which the plaintiff was apprehended and committed? The plaintiff was a stranger, and his character totally unknown to the defendants. He took up his abode at an obscure tavern in the neighbourhood of the defendant's manufatory, where he contrived to procure frequent interviews with the workmen employed there, for the purpose of seducing them from their engagements with the defendants, and of obtaining from them a knowledge of the machinery and process used in the manufacture of gunpowder, which the defendants had carefully endeavoured to keep secret. He offers one of them in particular, Boughman, a reward for bringing to him a brass pounder, or a pattern of it. The pounder was brought, was afterwards concealed, and about the same time Boughman secretly absconded. The plaintiff came to Philadelphia, and although soon afterwards he knew that the defendants were also in this city, and suspected that they were following his footsteps, as he expressed it in a letter to his employers, yet when arrested by the constable, he denied his name, and put to that officer a question by no means calculated to allay the suspicions which existed against him. The letters taken from him by the alderman disclosed fully the objects which had carried him to the neighbourhood of the defendants, and contained certain allusions to the articles of machinery which the defendants had missed.

Called on to declare an opinion, whether these circumstances afforded a probable cause for the prosecution in relation to the brass pounder, the court feels no hesitation in saying, that they did: and still further, that the plaintiff has no person but himself to blame for that prosecution and the sufferings it occasioned. A man may undesignedly and innocently become the object of suspicion, and of unmerited, tho' justifiable prosecution. In such a case he may with great propriety call upon his accuser to acquit

himself, by strong evidence, from the charge of rashness and malevolence, before he can claim to be excused from the consequences of his conduct.—But if he has intentionally acted in such a manner as to connect himself in the supposed guilt, and has in fact participated in it, shall he be permitted afterwards to complain that he had become an object of suspicion, and claim the assistance of the law to compensate him for the losses to which he had thus exposed himself? In this case the brass pounder was taken and carried away, at the instigation of the plaintiff, was in his possession, as he afterwards acknowledged, and was then concealed by the person who took it, and who afterwards absconded—and does it now lie in the plaintiff's mouth to say, that the defendants had not probable cause for suspecting him as the felon? But it is said that still there is no proof that a larceny was committed by any person, and that such proof is essential to the defence. Without determining conclusively upon the soundness of this doctrine, I must be permitted to express the court's hesitation in approving it. It would seem to demolish the whole ground of defence allowed to a defendant in this action, if notwithstanding the strongest circumstances of guilt, the *motives* of the action should, upon a full examination of the evidence to be furnished by the person suspected, turn out differently from what they appeared—if probable cause shall excuse in relation to the person suspected, and yet afford no protection as to the offence supposed to have been committed. But it is by no means to be admitted, that a larceny was not committed in relation to the brass pounder. Baron Eyre defines larceny to be "the wrongful taking of goods with intent to spoil the owner *causa lucri*;"—and what are the facts in this case? Boughman secretly took and carried away this instrument for a reward promised him by Munns, as is proved, and concealed or otherwise disposed of it, so that it was lost to the owner. Whether his intention was to spoil the owner, or to convert the article to his own use, would be a proper subject of enquiry with a jury upon all the circumstances of the case.

But it is proved by two witnesses, that the plaintiff afterwards acknowledged that Boughman had *stolen* the pounder, and whe-

ther in technical language he had done so or not, the plaintiff cannot in this action make it an objection that in point of strict law a larceny was committed.

As to the three drafts of machinery charged to have been stolen by the plaintiff, it must be admitted, that the defendants proceeded, not only without probable cause, but without any cause at all. It does not appear by the evidence, that the defendants ever possessed such drafts, and consequently they could not have been deprived of them. This charge (which is certainly unfounded) being connected in the same warrant with another, which was founded, may or may not have produced injury to the plaintiff; and if in your opinion it did so, and was moreover maliciously made a ground of prosecution, the plaintiff is entitled to a verdict on that account for such damages as you may think proper.

I shall notice the warrant taken out by the defendants in Delaware, merely for the purpose of observing, that it is not made a distinct ground of charge against the defendants, and is relied upon only as a circumstance to prove malice. Of course no damages could be given on account of that procedure, even if it had been made without probable cause: and if the defendants had probable cause of obtaining the first warrant, the grounds of suspicion had received additional strength before the second was granted, the plaintiff having previously acknowledged that the pounder had been stolen by Boughman, brought to him, and afterwards concealed.

The second ground of complaint is, the indictment against the plaintiff, in Delaware, for having received five pieces of parchment, four of them perforated with holes, knowing them to have been stolen. How stands the fact in relation to these articles? It is in full proof that Peebles, one of the defendant's workmen, employed in their factory, by the plaintiff's procurement, cut from the parchment seives, belonging to the defendants, without their knowledge or consent, a number of pieces of different sizes, which Munns afterwards had in his possession, and which were produced on his trial. And if this evidence required any support,

the finding of the bill of indictment, and the agreement of the plaintiff' counsel to pay the costs of that prosecution, which the law excused him from doing, unless a certificate of probable cause was granted, are conclusive upon the point of probable cause in this part of the case.

Upon the whole, the plaintiff is not entitled to a verdict, as to the two charges, which respect the pounder and seives, because, though he should have proved malice to your satisfaction, the defendants have justified themselves by proving probable cause for those prosecutions. As to the three drafts of machinery, you are to decide whether that charge was maliciously made, and was productive of injury to the plaintiff.

When the jury returned with their verdict, the plaintiff, declining to answer when called upon, suffered a nonsuit. The opinion of the jury however, was declared to be for the defendants.

ON GENTLEMEN-FARMING.

No. I.

Tackoney, Feb. 23, 1811.

DEAR SIR,

PERHAPS nothing has been more injurious to the interests of the agriculture of this country, than the disappointments which gentlemen farmers have met with in that pursuit; for their talents and capital, had they been properly directed, were calculated to diffuse information and good husbandry throughout the whole country; and the express intention of this communication is to prove, that the cause of those disappointments have originated from a mistaken practice, and to detect and expose those mistakes; and also to point out to future adventurers in this business, the mode of management from which they may rationally expect success. In order to enforce what I shall advance on this subject, it is necessary to observe in the commencement of it, that the best writers on agriculture agree, that it cannot be profitably pursued by the gentleman farmer, without superior cultiva-

tion and excellent management; and that justly celebrated author Arthur Young, has clearly demonstrated, that it is impossible for a gentleman to farm without considerable injury, and perhaps ruin to himself, and disgrace to his adopted profession, without a sufficient active capital, a regular system of accounts, and superior husbandry, the practice of which he very clearly proves, is not to be gathered from the numerous publications on that subject, which have been founded either on falacious arguments or superficial experiments; but from the actual practice of farmers, which when seen and known, may be acted on with certainty as well as success; and it is only from such a practice as this, joined with proper attention and economy in his business, that a gentleman farmer can expect to balance the advantages which the common farmer derives from his superior experience, together with his own labour and that of his family. As I ride through the country, and pass by farms which have been deserted by the gentlemen to whom they belong, and can observe but few if any marks of this superior cultivation and systematical management, I am obliged to conclude, that too little attention to the magnitude of the subject, has spoiled a farmer, whose talents and capital might have done honour to the profession; and I am still more fully convinced that those gentlemen have not sufficiently considered the value of systematical farming, and consequently are not acquainted with the subject, or they would not have rented or let out their farms on shares, to men whose capitals are not only insufficient to cultivate them properly, but who, after rating horses and implements of husbandry, and a scanty supply of milch cows, have little or no other capital, and are frequently very deficient even in those. In this way are many fine estates, scratched, tortured and butchered from year to year, until their fertility has been so exhausted, that some of them will scarcely bring one per cent. per annum, clear of charges on their original value, and some others it is probable bring their proprietors in debt; and although it may be found difficult to procure tenants possessing sufficient capital, yet sober, honest, and industrious farmers might be selected, who, with the aid of some cash on interest, together with some

advice and attention from the proprietor, would be enabled to carry on their business with advantage to themselves and improvement to the soil: for lands have been let out on improving leases in other countries, and I do not see why the same thing may not be done in this. Nothing is wanting but attention and application to effect this purpose, or to farm to advantage; for the abilities of those gentlemen cannot be doubted by those who have had an opportunity of observing their management in town, where the experience of ages has confirmed the sentiment, that a sufficient capital, regular accounts, proper information and attentive personal application, are indispensible to the prosperity of either mercantile or manufacturing pursuits; and that disappointment, and perhaps ruin, may naturally be expected, when the management of such business is confined to clerks, journeymen and apprentices. If the same regular system had been established in the country, gentlemen might have farmed to advantage, but it is evident this has not been the case, for although the anarchy of ancient farming has been changed to a good system, which may be as readily taught, and practised with as much rational prospect of success, as any other business; yet if Arthur Young may be believed, there had been little or nothing written on the system of the general management of farming until he commenced that subject in his "*Rural Economy*," consequently there has not been sufficient time for the same correct management, which has been improving for ages in cities, to get established in the country, where custom from time immemorial, appears to have established the opinion, that rural pursuits are so plain, easy and simple, that they do not require regular accounts to direct and guard their interest, or a laboured system of well proportioned management, under the immediate direction of the proprietor, and it is well known, that it requires time to root out habits which have been completely established from the practice of an age, notwithstanding those habits may be not only highly injurious to the individuals who practice them, but also to the community at large.

Nothing has been so fatal to the interest of agriculture as this erroneous opinion of the simplicity of that science, which opens a

multitude of unsuspected avenues to profit or loss, that cannot be either known or understood, but through the medium of correct accounts and intelligent indefatigable attention; yet gentlemen have entirely overlooked this subject, and conceive it unnecessary to exercise their qualifications in this supposed simple business, and when they commence farming, fall into the general practice, and either let out their grounds on shares, or hire a farmer to superintend the business. As the first method naturally introduces opposite interests between the landlord and tenant, it requires no observations, but as the other practice is much more rational, it demands consideration.

It is supposed the gentleman gets a farmer well acquainted with his business, industrious, sober, intelligent and honest; with such a man, together with the attention the gentleman may consider necessary to bestow on the business, there can be but little doubt, that his crops will be equal, and perhaps superior to the crops of the best common farmers in the neighbourhood, and such as would without question, in the course of time, enrich a common farmer, who aided the business with his own labour, together with the labour of his own family; yet crops obtained through the round of the best common practice, will certainly bring the gentleman very considerably in debt, after he has paid the expenditures of the farm, and has charged interest on the money vested in it, and employed thereon, and made due allowance for wear and tear, and deficiency in the yearly value of horses, &c. Nothing short of a general *assemblage of the very best productions*, and *best cultivation* that is practiced in the country, can possibly secure success to the gentleman farmer; and these are easily obtained, by industriously gleaning every thing that can be discovered valuable in agricultural books, and in the practice of others, and through the medium of this simple but certain means, the attentive agriculturalist may in a short time double the production of his gounds, without risking the uncertainty of farming from theory. He will also obtain from this mode of practice, aided with correct accounts, more real information in three or four years, than he could acquire in ten or twelve years in the usual way;

and although the agriculture of this country has not been brought to so high a state of perfection as that of Great Britain, there are farmers here whose industry, ingenuity and crops, would claim respectability either in that, or in any other country. It must be a poor farm indeed, which exhibits nothing worthy of the keen eye of the industrious gleaner, for even the short cuts of slovens may sometimes discover the best mode of cultivation obtained at the least possible expense, and although it may cost the gentleman no very considerable share of riding to obtain all the information he wants, yet after it has been procured, it will be invaluable; he may soon acquire knowledge sufficient to engraft improvements on the best cultivation of his country, which will open full scope for future experiments and industy. How much wiser and safer is such a course, than the introduction of foreign plants or implements of cultivation, with which his workmen are entirely unacquainted, while he is himself incapable of instructing them! yet it is certain, that cautious trials of this sort in the hands of skilful cultivators, may be rendered highly beneficial to themselves and the agriculture of their country.

Nothing can be more certain, than that an intelligent workman or farmer, is absolutely necessary to the gentleman, particularly at first, yet in general, their habits reduce them to a level with the rest of the workmen, they are his associates and their faults and improprieties of conduct will be concealed, unless it is found necessary to divulge them in order to screen himself, and although the gentleman in the common conduct of his business must necessarily depend much on the judgment of this man, yet his own eye should carefully inspect every thing which is done on the farm, and every order or instruction to his workmen should emanate immediately from himself, and his conduct should convince them, that he did not depend on his farmer to see that his orders were properly executed. It will also be found an invaluable practice to accustom the farmer, and every other workman on the place, to wait on him at a very early hour every morning, for the orders of the day; it will establish early rising, and prevent much loitering before business commences, especially if they are taught to expect

that the gentleman's eye will pursue them. The watching of their motions will be attended with but very little trouble, after it becomes generally known and established that the gentleman is determined on order, regularity, and industry, especially when they discover, that every transaction of the farm is registered, and that precedents may be produced of the labour done by others to expose their idleness; they dread the quill in the hands of their employer more than a cudgel; provided the gentleman preserves a dignified conduct, and has no other conversation with them than what immediately relates to their business: for in a country where liberty and equality are established, pre-eminence is only founded on superior merit, which is too rarely distinguished by this class of people, he therefore will certainly sink in their estimation, if they are treated with the least degree of familiarity, yet an affable and humane attention to their interest and comfort, both in sickness and health, is equally necessary to secure respect and prompt obedience from them.

Prudence will dictate the keeping as few workmen as possible during winter, for short days and inclement weather curtail business exceedingly, especially if breakfast is not over in time to commence business soon after it is light, and neither farmer nor workmen will be stirring, if they suspect the cultivator is in bed: but it is presumed no gentleman will engage in farming who does not, sportsman like, value his game in proportion to the ingenuity and exertion which has been bestowed in the procuring of it, for it will certainly be found, that no other characters are fitted for the purpose, and that a gentleman cannot farm by proxy with any more rational prospect of profit or reputation, than a physician could practice by sitting at home in his easy chair, and sending apprentices to visit his patients.

Your respectful friend, &c.

JOHN LORAIN.

JAMES MEASE, M. D.

OBSERVATIONS

On Carriages, Roads, and the Draught of Horses.

BY J. W. BOSWELL,

From the Reports of the British House of Commons.

TO determine the best construction for wheel carriages, several circumstances must be taken into consideration, and their operation on each other be duly estimated. If there should be any error, either in the statement of these circumstances, or in the estimation of their effect on each other, the conclusion drawn from such premises must be inaccurate. Hence has arisen the variety of opinions which have been published on this subject: for few men have considered all the circumstances which affect it; fewer still have allowed each its proper weight; and some who come nearest to those essential points, have not been strictly accurate in all their statements. Fortunately, the subject is capable of mathematical investigation at each step; and errors of the above nature will in time be corrected by men of science, in revising what is published by each other relative to it, and the accurate truth may at length be attained in this way. But if mere opinion is to have any sway, without any estimation of the qualifications of the person who gives it; if the crude notions of the ignorant, prejudiced, and obstinate peasant who drives a wagon, are allowed the same weight as the results of long continued and reiterated investigations of the most able proficients in the philosophy of motion; ignorance and prejudice must rule triumphant, truth must still remain in obscurity, and millions of the public money must be every year wasted in repairing roads, to gratify the barbarous satisfaction which wagoners find in grinding them to powder with conical wheels on bent axles, and in ploughing them up, by laying such enormous weights on four ill constructed wheels, as would require at least twenty of the best form to carry them without injury to common roads.

But what is very bad for one purpose, often may be good for another. These heavily-loaded conical wheels, though forming an engine most destructive to roads, might however be found

useful in agriculture. Let us only double their breadth, incline their axles a little more, and convert their rose-headed nails into spikes, by merely quadrupling their usual projection, and we shall have an implement of husbandry, which in once going over a ploughed field, will break down and pulverize the soil more than five harrowings. Let only spiky cones be fairly tried in farming, and spiky rollers will be no longer used.

In computing the due proportion which the load should bear to the number of wheels, the practices of those who employ carriages on roads, the entire cost of which fall on other people, and who make others also pay for their errors, should not have much weight. In such cases the worst management may continue for ever. But in considering an example of a contrary kind, the truth at once shines forth. Let the management of roads made at private cost, and as a trading concern, be viewed, and a totally different scene is presented. Such a road is within a few miles of the metropolis; and though it is constructed on a principle better calculated to support ten tons on four wheels, than a common road is to sustain one on the same number, yet here we see the utmost care taken that no single wheel shall carry more than five hundred weight and a quarter, or two and a half tons for each carriage of four wheels; while on the common roads, for which the public pay, ten tons are frequently carried on the same number of wheels. The road alluded to is the iron railway from Wandsworth to Croydon.

But it may be said, that increasing the breadth of wheels will have as good an effect as increasing the number, where a great weight is to be carried. That this is a mistaken opinion, will be demonstrated farther on. But let it be considered here, how the measures hitherto planned for promoting the use of broad wheels have been treated; they have been in the first place completely evaded, and what is still worse, the course of this evasion has given rise to the most destructive engine that ever was used for breaking up roads, the broad conical wheel with rose-headed nails. And now, when prejudice itself cannot deny this truth, we are formally told, that a method has been adopted to prevent the

injury which they occasion, and that by rounding the surface of the sole they no longer act as cones. But if they do no longer act as cones, they act as segments of spheroids. And the same ingenious* gentleman who has so ably proved the destructive nature of conical wheels, has also proved those of the latter shape to be no less injurious in soft roads. But on hard roads only a part of their soles touch the surface, and hence arises their fallacy; on hard roads they are more destructive than narrow wheels, as they are much heavier, while they rest on a smaller surface; and in soft roads they are complete grinding machines, and are thus formed for universal destruction, for where they cannot grind they will cut, and on this account no road can long stand their action in a firm state.

The importance of the proper form of axles for cylindrical wheels is evident, for if these are not straight, the wheels cannot possibly act right: and also it is plain, that more attention and knowledge is required in performing experiments of this nature properly, than is commonly imagined; that every one is not qualified for the task, and that the more respectable gentlemen are, who undertake them without previous instruction, the more mischief is done by false results, as their respectability adds weight to error.

One objection to cylindrical wheels has been made with more semblance of truth. It is asserted, that level cylindrical wheels resting on rounded roads, can touch them only with their angles. But those who make this objection do not sufficiently consider, that when the circle is very large, that small portions of its circumference may be considered as levels, as the surface of a pond is estimated a level, though in strict truth, it is a segment of a globe. In most roads no perceptible variation from flatness will be found in the extent of the axles of those wheels; some few badly shaped roads may occur where this inconvenience would take place, but none where it would happen in any degree similar to that represented in the diagram of the 5th plate of the first Report, which, from its neglect of proportion, is calculated to

* Mr. Cumming.

mislead public opinion on an important point. On smooth well-formed roads of the usual curvature, cylindrical wheels would act nearly the same as on level road, but on rough ill-formed roads they would often rest on their angles and act badly, if managed as hitherto proposed: but even for these roads they may be adapted so as to be free from all objections of this kind, as it is hoped will be made plain in the plan I shall propose further on, for wheels on new principles, which I hope will obviate this and several other difficulties.

OF CARRIAGES.

It is obvious that the mode of conveying goods on a road, which is most advantageous to the public, is that by which a horse can transport the greatest load with the most ease to himself, and the least injury to the road. These important conditions are so fully attained by the use of single-horse carts, according to what has appeared in the Reports, from the clear testimony and fair experiments of Mr. Arthur Young, and other gentlemen, that no doubt can remain on the subject. There is one advantage of single-horse carts, which however has hitherto escaped notice, which it is proper to mention. In every single horse-cart the horse must carry a part of the load on his back, and as this part is conveyed without any injury whatsoever to the road, this fact affords an additional argument for encouraging the use of such carts, especially as this load, so far from embarrassing the horse, enables him to draw the rest with less muscular exertion, as will be proved in the paper which accompanies this. The necessity of this load being placed on the horse, arises from its being the only method of preserving the whole load from tumbling backwards in going up hill; the weight of this load must be an eighth or tenth of the whole, for less would not preserve the equilibrium of the cart up a hill, ascending only ten degrees from the plain. And supposing it is only a tenth part of the whole, from this circumstance alone, there would be a saving of a tenth part of the expense of repairing roads; which would amount to a prodigious sum annually, if this mode of conveyance were universal over the whole kingdom.

The objections made to this method of carriage appears very futile, to those who have seen it practised in Scotland and Ireland, where greater loads than what are carried by any single wagon in England, are conveyed in this way with fewer drivers; for two men can drive a chain of carts with ease and safety, which will carry more than two wagons. Horses follow each other in this way with great readiness, which accounts for the facility of driving it affords. But even if carts required double the number of drivers which would be sufficient for wagons, still the great saving that would arise from their use, in every other respect, would amply pay for this difference. Two-horse carts should never be permitted, unless both horses helped to support the load, which is easily effected by a pole and cross-bar, in the same manner as it is done in a curricle: some country carts to which horses are attached in this manner, are seen occasionally at the east end of the town. One-horse carts furnished with springs would afford the most advantageous mode of any for conveyance: many carts have now springs beneath them, of the kind called horizontal springs, which probably would be the best for common use, and they can easily be made strong enough to sustain any load which a single horse can draw. Mr. Lovell Edgeworth was the first who pointed out the great benefit of springs in aiding the draught of horses. The subject, on account of this benefit, deserves more attention than it has hitherto met; no discovery relative to carriages has been made in our time of equal importance, and the ingenious author of it highly deserves some mark of public gratitude in return. Yet so slow are improvements in getting into notice, that though this fact was published more than twenty years ago, it is still so little known, that the following erroneous opinion, by a gentleman who ought to have known better, has been published, and is again repeated in the first Report:* "It is sufficiently obvious, that a short, stiff, unelastic carriage, must be easier drawn than any formed on a contrary principle." The known liberality of this gentleman will cer-

* This alludes to the reports made to the House of Commons on roads. *Editor.*

tainly lead him to acknowledge his error on this subject, as soon as he has perused Mr. Edgeworth's excellent memoir on springs. There is an advantage in springs that seems to have escaped notice, which follows obviously from their other good qualities, and in a public view is as important as any: this is, that they save the road from injury at every jolt they prevent; they also hinder the displacement of some of the materials of the road: and this circumstance alone would enable a road to last longer without repair where spring carriages alone were used, than one where those without springs were employed, even though of the best construction in every other respect. When they add to the safety of the load, the ease of the draught, and the preservation of the roads so much, as various papers published relative to them have proved, what more can they require to deserve universal adoption?

OF ROADS.

Of the various modes of conveying goods by land, none have come in competition with iron railways. Proof on this point is so easily attained, that little need be said on the subject. The great saving they would occasion to the public, not merely in the conveyance of goods, but in diminishing the expense of repairs of common highways, deserves the most serious attention, and renders every mode that can be devised to encourage their farther adoption a point of obvious policy. The following plan for the purpose appears not liable to serious objection: Most of the great highways in the kingdom are sufficiently broad to allow of a rail road at each side, without any inconvenience; they would not require more space than that usually appropriated to a footway; and might serve also as footways, as there would not be so many carriages on them, as to make it inconvenient to foot passengers to step on one side occasionally as they passed them; which would also seldom occur, as the pace which both usually move in is nearly the same, and there would be a railway for each direction. If liberty were granted to companies, or private persons, to erect railways on such places, the advantages to the public above stated would amply pay for the value of the land they occupied; and such

would be the profit to the owners of these railways, that in time a small annual rent might be required from them, and this might be increased as the profits become greater; in which case, in many situations, they would in a few years pay for most, if not all the repairs of the highways along which they were made. These railways should be left entirely to the management of the proprietors, as to the best mode of using them; they could only be used for the conveyance of goods, as carriages for passengers could not pass on them, at their usual swift pace, while loaded carriages were on them. The best mode of forming iron railways is that in which the rail rises up a few inches above the level of the ground, and is received into a groove in the wheels, which move on them; as on such rails no gravel can lie to interrupt the motion of the wheels; and if with such rails, the wheels were formed flat at each side of the groove, so that they could occasionally run on common ground, the whole perhaps would be as convenient as could be wished.

Stone railways have been proposed, and certainly deserve a fair trial, notwithstanding their being more liable to wear than iron. But even if it should be necessary on this account to have copper rims to the wheels which moved on them, from copper being so much softer than iron, the difference of the expense of this arrangement would form no serious objection. In those proposed by Mr. Matthews there is a slight defect (though they are very perfect in other respects) in the mode of making the tenons to unite them, which are directed to be shaped *obliquely*: and it is here the defect lies, for each of these oblique tenons would form a wedge, which, when the stone was put in motion by the passage of a heavy carriage, would tend, with a considerable mechanic power, to force the stones asunder; and that the stones would acquire a vibratory motion from the passage of heavy carriages cannot be doubted, when it is so well known, that the loaded wagons in passing through London make the very houses shake sensibly at a hundred yards distance. There would also be a great waste of stone caused in forming these tenons. For these reasons it would be safer, and more economical, to

unite the stones by small separate blocks let into their substance at the bottom, in the same manner as the large curb stones round the West India Docks are united at the top. It is very probable that even a stout oak trennel let into the centre of each, in holes cut to fit them, would hold stones sufficiently together, as but little force would be required to keep them together when once they were properly bedded. The foundation on which these stones were laid should be strictly attended to; it would perhaps be as cheap a mode as could be devised of laying one for them, to pave the bottom of the trench, which should be cut to receive them, with common paving stones.

Next in order to stone railways, the most durable road for heavy carrriages, and that of least annual cost (including the interest of original expense) would be a paved road, which should be accompanied by a gravelled road for light carriages: the paved road need not exceed fifteen feet in breadth, as that would allow two carriages to pass with ease. There would be no necessity of imitating the arrangement of the Commercial road, in having the paved road placed between two gravel roads: though if the concourse of light carriages should be so great as to render a third road of the breadth mentioned necessary, the only objection to having the paved road in the middle would be, that as it would be less injured by the wet than the others, it would be best to place it in the lowest situation. The manner of dividing high roads into separate ways, which would be necessary when a paved road was used, would also be extremely beneficial in all cases where the space allotted to the highway should exceed thirty feet in breadth. The advantages of this method of forming roads with double ways has been published some time, but the name of the author has escaped my memory. 1st. They would require but little more than a fourth of the materials to form them at first, which would be necessary for roads of a single way of the common shape. 2d. They would remain much drier, and of course be more durable, as the water would not have half the distance to run off them, while the inclination in both cases, at equal distances from the summit, would be the same. 3d. They would

afford a double convenience for carriages, and would be more equally worn; for in roads of a single way, the carriages run on the highest part, that the pressure of the load may be equal on the wheels at each side; hence on these roads, two-thirds of their breadth remain in general unoccupied; but double roads would afford two such elevations, and consisting of the parts of equal curves most near to a level would be more equally worn, as no part of them would obtain much preference to the rest on this account.

The double road should have an open gutter or drain in the middle, with covered drains passing beneath the road at proper intervals, to discharge the water into the ditches; very few more of these would be required than what are necessary for a single curved road, to discharge the water from its higher side to the lower. If the highway exceeded thirty feet in breadth, from a similar mode of reasoning, it may be proved that it should be formed into as many curves, or round ridges of fifteen feet base, as the space would allow; and such roads would have all the advantages of flat roads in equality, while they would not only be free from the liability to retain water, which forms the principal objection to these last, but even in this respect be much superior to roads of a single curve.

The necessity of submitting the management of roads to regular engineers, instead of to that of the ignorant and interested persons who have in general had the direction of them, has been ably shown in some of the papers of the first Report. A very slight inspection is sufficient to convince any one, that much might be saved in the length of the most frequented roads, by adopting more judicious tracts for them in various places, which experienced engineers could readily point out. A saving in the length of a road is certainly a great advantage; but there is another point of much more consequence in the course of roads, which requires more attention and calculation to appreciate, and which is therefore still less attended to. Few know its great importance; to point out this to its full extent would much exceed the limits to which it would be proper to extend this com-

munication; but the following observation, it is hoped, will include the most material circumstances. This very material object is, the preservation of the *levels* of the road, through the neglect of which, much more expense is incurred in the carriage of goods than most would imagine. A horse drawing at the rate of three miles in an hour, can overcome a resistance equal to 70 lb. without unusual fatigue, for a continuance. This force is sufficient to move a ton weight with ease, on a proper carriage, along *level roads* of the ordinary sort, (in fact, it is equal to much more, but this will be sufficient for the calculation). To raise this ton weight from the bottom of a well vertically, by a cord over a pulley, according to the above allowance of force, thirty-two horses would be required. As there are ninety degrees between a vertical line and a level, for this reason alone, an additional horse should be used for about every three degrees which a hill ascends above a plane: but this number must be more than doubled, from a consideration relative to the horse, for if you place him on an ascent so steep, that a line let fall from his centre of gravity must be vertical, he can but barely move himself up the hill, but will not be able to draw up it any load whatsoever, because his weight will be perpendicular to his point of motion at his hind foot, and can therefore have no power to assist him in any of the mechanical modes of action, (explained in the second part) by which he moves himself forward. But on an ascent of 44° the horse will have power to draw up a certain weight, which supposing it to be in proportion to what he draws up vertically over a pulley in a level line of draught, or 70 lb. thirty horses will be required to draw a ton weight up this ascent. The proportion of force required will not, however, be equally divided between all the degrees of elevation, for it will increase more rapidly at the higher than the lower degree of ascent, and much more in the five upper degrees than in all the rest. It may be found for any degree of ascent by marking the distance which the vertical line, let fall from the centre of gravity of the horse, is from the centre of motion or hind foot, on the horizontal line; which, compared with the similar distance when

the horse stands on level ground, will show how much less power the same horse will have on the ascent than on the level, and of course will show what additional force will be requisite to draw the load up the ascent. The distance of the above vertical line of the horse on the ascent, from the vertical on the level, will show what proportion this additional force should bear to the force when he draws on the level; for as this distance is to the whole distance of the latter vertical from the centre of motion, so will the additional force requisite be to the whole force acting on the level.

Experienced engineers have valued the power of a horse drawing on a level plane differently: Smeaton states it to be equal to the elevation of 22,916 lbs. one foot high in a minute; and Messrs. Bolton and Watt consider it equivalent to 32,000 lbs. raised with the same velocity. The first will be equal very nearly to 86 lbs. raised at the rate of three miles in an hour, in the manner before-mentioned; but the latter will be the same as 121 lbs. raised at this last rate. Others value it at the rate already stated, of 70 lbs. The powers of different horses must be various; but though this will cause an alteration in the number requisite to draw a given load up a hill, it can make none as to the proportion the number must bear to that necessary to move the load on a plane.

Of the Mechanical Modes of Action of the Horse.

A HORSE, besides his muscular strength, possesses powers of a mechanical nature, from the mere structure of his frame combined with his weight. When he rests on his hind legs and raises his fore feet from the ground, he exerts the most simple of these powers, which has been compared to a bent lever in its mode of operating. But the comparison is not accurate, for if he draws by a trace attached to his breast in the usual way, the trace has no connection with the vertical part of his figure, and therefore cannot be influenced by its motion; to enable the horse to operate as a bent lever, the trace must be attached in fact to some part of his hind legs.

When the horse is in the position above-mentioned, and keeps the joints of his hind legs and his back stiff, his force will be more exactly represented by a straight lever extended obliquely upwards from his hind foot, (the centre of motion) to the point of draught. And a weight equal to that of the horse attached to the part of this lever, which lies perpendicularly under his centre of gravity, would move as great a load as he could in this position.

From these facts the following inferences proceed:

1st. The higher a wheel is, the less will be the power which the horse, applied in the above manner, can have to move it forward.

2d. The horse will have more power over a load on the ground than over one placed on any wheel; and the closer this load is to his hind foot, the greater will be his power over it in this way; but in this case it is necessary that the plane on which the load lies be perfectly hard and smooth, and that the lower surface of the load be so also.

3d. The farther forward the centre of gravity of the horse is placed, the greater will be his power applied in this manner.

Hence the impolicy is evident of the cruel custom of curbing horses heads close to their breasts, for, by protruding the neck, the horse can advance his centre of gravity very considerably, and increase his power over the load in proportion, whenever great exertion is necessary in bad or hilly roads. Hence also, long-bodied horses will have an advantage in slow draught over those which are shorter.

4th. The power of the horse in this position is diminished by having the point of draught before the centre of gravity, because thus the resisting lever is so much longer than the acting lever.

Hence the horse's power would be increased, in this way of applying it, if the point of draught could be placed nearer the centre of motion than what the centre of gravity is; a mode of doing which shall be described.

5th. A weight placed on the horse's back increases his power

applied in this way, for in the given position of the horse his power arises from his weight alone; therefore by increasing the weight on his body the power will be increased; but this weight should not exceed 200 cwt. or the muscles of the legs and loins will be too much strained.

Hence the advantage of single-horse carts, or those double-horse carts drawn by a pole and bar, wherein the horses draw abreast and sustain equal portions of the load is manifest; for by them a part of the load can be made to assist the horses in drawing the rest.

Horses drawing carriages with low wheels always use this way of increasing their power when a greater draught is required. Horses in the Irish cars use it frequently; which may account for the great advantage of this convenient and cheap carriage, so justly remarked by Mr. Arthur Young.

The Irish roads, being in general harder than the English roads, do not require such high wheels, and therefore admit of wheels sufficiently low to enable the horse to exert his power on them to advantage, which he could not do with high wheels.

The Irish car is of a kind very seldom used, being acknowledged the worst; that in general use rests on iron axles *outside* the wheels; these are always truly *cylindrical;* and the small inconvenience of their requiring a little increase of force to draw them round in a short turn is of very little avail, when it is considered how seldom it is necessary to turn them, and what a small proportion the time of turning bears to the time employed in direct draught. But even this slight evil has been obviated in some cars, made with a separate axle to each wheel meeting in a socket fixed for them beneath the centre of the car; but the slightness of the inconvenience has prevented this last species from coming into general use. The ignorant and prejudiced will still continue to despise these cars, but the skilful mechanist will admire that simplicity of construction of which the others have not skill to appreciate the value; and to the man of sense, their cheapness will not diminish their merit; while their great convenience in loading and unloading will ever afford them a

powerful recommendation. If they should be ever used in England, on account of the greater softness of the roads, the height and breadth of the wheels should be increased; they may also be formed in this case with spokes and fellies; but the solid wheels have the advantage, besides their cheapness, of not gathering dirt in deep roads.

6th. The load drawn on high wheels, by the horse using this mechanical action, will be moved forward at an unequal pace, sometimes quicker, sometimes slower, which must be injurious to the horse, from the great difficulty he would find in suiting his force to it, and would in some cases cause him to stumble.

7th. Wheels intended to be acted on by the described motion of the horse, should never be so high as that a line drawn from their axles to the point of draught, should form an angle of ten degrees with the horizontal line drawn through this point. For when the axles were at this height, the distance advanced by each depression of the horse, would be equal to the distance the wheel was pulled forward by it, and every excess of height above that must be subject to the inconveniences attending on too high wheels, above related, as the distance which wheels above that height would be moved forward by the first depression of the horse, would exceed the space which the point of draught would be advanced by that depression.

A second mechanical arrangement for the horse's frame, is when he rests on his fore and hind feet at the same time, & leans forward.

1. All the rules relative to the height of wheels which were stated of the first mechanical mode of action, will also apply to the second, for the same reasons. Low wheels are in both cases the most advantageous, and high wheels have the same inconveniences; and the axles should equally never exceed the height of ten degrees below the horizontal of the point of draught.

2. The best position for the centre of gravity is different in this way of applying the force of the horse from that first described; for, instead of being most advantageous when placed far forward, it in general will have most effect in the middle.

3. Weight laid on the horse's back increases his power in this

mode of action as well as in the former, and he can bear a greater load in it, because his weight is more equally supported, as he, when using it, rests on his fore and hind legs at the same time.

The horse generally uses this species of mechanical action when he walks in drawing a load; and as in the former mode he moved the load by the action of his shoulder, in this he acts by depressing and elevating his crupper also at the same time.

The horse uses a third species of mechanical action besides these described, in which he rests the fore part of his body on his fore legs, so that in moving forward the point of draught keeps the same level; his hind leg being at the same time in an inclined position. The most favourable position for the centre of gravity in this case, will be far back.

When the horse trots, in drawing a load, his force is applied very differently from what has been stated in the former cases: his action then consists in a succession of impulses, in each of which his weight acts with an accelerated velocity, as a sledge operates in striking horizontally. The force gained by accelerated velocity should be arranged among the primary mechanic powers, on account of its universal application in the simplest engines we use; all kinds of hammers and rammers are of this nature; the wedge is seldom applied without its aid, and is combined with it in hatchets, axes, adzes, and all instruments which cut by striking; therefore there would be no impropriety in arranging this application of the force of the horse, as the fourth species of his mechanic action.

The height of the axle should in no case exceed the level of the point of draught, for in every wheel above that height a part of the force of the horse would be lost in drawing the load directly downwards, bearing that proportion to the part of his force exerted in the draught straight forward, that the excess of the height of the axle above this level bore to the distance of its perpendicular from the point of draught. If the velocity of motion were very great for which the carriage was required, and that it were always to move on a level surface, the wheels might

be made perhaps nearly so high, that their axles would be on a level with the point of draught; but for the common rate of travelling, they should never exceed the height at which a line from their axles to the point of draught would be ten degrees below the level of that point, because in common roads a small pull upwards enables the wheel to pass obstacles more easily, and they would not be subject to the inconveniences which would attend wheels above that height in the use of the three first explained mechanical modes of action of the horse, which in bad roads, and up hills, it would be necessary that he should use occasionally; and reasons will presently be shown why in hilly countries they should be considerably below this standard.

Carriages drawn with a swift motion are known to have their pressure on the earth diminished. This is easily accounted for on established principles. But there is another cause for this diminution of its weight by velocity, which acts still more forcibly; every obstacle which the wheel touches causes it to rebound from it, and the smaller this obstacle is, the more directly upwards will this re-action be, and the greater the velocity, of course the higher will it raise the carriage; the velocity of forward motion still continuing, the carriage will be drawn forward while in the air, a space double the height it was raised above the earth, if the velocity is eleven miles in an hour, and more than this if it is greater. These two causes combining together, will make the carriage move forward by a succession of small leaps, instead of a regular rolling motion, which on a hard pavement are very perceptible to an attentive observer, even at the usual rate at which carriages move in London: this leaping or bounding of the carriage assists the horses much in drawing it, as during the time it remains above the ground, the resistance is very little more than what its surface opposed to the air occasions. The use of springs much aids this bounding motion, by causing the re-action of obstacles to be more perfect in raising the carriage, and by preventing the motion from being lost in displacing the substance of the road, and thus at the same time preserving the road. It may be worth while to observe, that the practical benefit of this bounding mo-

tion, and the advantage of elastic mediums in increasing it, were known and used by chairmen long before the excellent theory of the use of springs in wheel carriages, which does so much credit to the gentleman* who investigated it, was published, or indeed before springs were used in coaches at all; for the dancing motion which they give the chair in carrying a load, by the elasticity of the long poles, aids them in moving it forward in a manner similar to that above described; and the spring of these poles assists in the same way as the springs of the chaise in prolonging the duration of the successive elevations of the vehicle: thus affording an instance, in addition to many others, where chance has given to ignorant men valuable gifts. But here is the point where intelligence exhibits its greatest superiority; the ignorant man can use the fact he has discovered only in the particular instance in which it has happened, and for himself alone; but the man of science can extend its application to numerous other matters, and has enabled mankind to know and participate in its benefits.

OF CARRIAGE WHEELS.

THE foregoing considerations of the manner in which the mechanical action of the horse influenced the determination of the height of wheels, have shown, that for slow draught low wheels are preferable on hard smooth roads. But as few roads are found which do not vary more or less from this state, it will be necessary to consider, what wheels are best for roads of other descriptions. For going over obstacles, and passing ruts, for sandy and for muddy roads, high wheels are preferable; nor are there any limits to the height of wheels for such situations, but the weight of the wheel and the strength of the axle (which would have to sustain lateral strains proportionally greater as the wheels were higher) if these points alone are considered. But on taking into the account what has been shown of the manner in which the height of wheels affected the horses, it will be evident, that

* Mr. R. L. Edgeworth.

wheels of the common sort should never have their centres higher than the level of the centre of gravity of the horse.

In going over an obstacle a high wheel gives the same advantage that lengthening the slope does to the ascent of a hill, in enabling the load to pass over the same height by a longer and more gradual rise at a smaller angle of elevation: the obstacle also re-acts against it, at the instant of percussion, in a less acute angle, in a direction more remote from the line of greatest resistance.

It is difficult to construct a diagram which shall represent the *whole* of the motion of a large wheel in going over an obstacle, compared with that of a small wheel; but it will be sufficient for every practical purpose to consider them at any one point of their passage. A wheel in going over obstacles is acted on by two oblique powers, one in the line of draught, the other in the line of descent perpendicular to the axle. By the usual way of finding the ratio of powers of this nature, these are estimated by drawing perpendiculars from the summits of the two obstacles of the same height, to the respective lines of draught of the different wheels, and a horizontal line through these summits to the vertical line of descent. It is necessary to state this, because the difference of wheels in this respect, is often noted erroneously to be as the height of the axles above the obstacle to the aforesaid lines drawn from the obstacle to the verticle spoke. Large wheels will also descend more gently on the road after passing the obstacle, in proportion as the arches formed by their axles, in passing from the verticle line of the obstacles to the former level, are greater than the arches formed by those of small wheels.

What has been stated relative to obstacles will also apply to ruts, as the ascent from a rut is precisely the same action as the ascent over an obstacle, and the descent into it is similar to the descent from the summit of the obstacle.

Large wheels are also more advantageous in soft and sandy roads than low wheels, nearly in the proportion of their height;

for in order to sink to the same depth they will have to remove a portion of the resisting substance greater in that ratio.

From these considerations, the advantages of high wheels for bad roads are evident; and as it has been proved that wheels low, relative to the size of the horse, gave him most power in a slow draught, it follows that large horses are best for drawing loads on bad roads, as the same wheel may be relatively low with regard to them, and positively high with regard to the road. But it is certainly infinitely preferable to make the roads good, and have such carriages as are best for the horses. The present state of the roads, however, though far from being perfect, is sufficiently good in general to render very high wheels unnecessary.

In going over hills, low wheels are decidedly better than high wheels. The greater weight of large wheels is the only circumstance that makes them inferior to small wheels in ascending, when they are considered without reference to the horse; but if the line of draught is the same in both sorts of wheels, the load will not press the high wheels downwards with more power against the resistance than the small wheel; for with a line of draught parallel to the hill, the proportion in which the load will act against the horse will be as the height of the axle to the distance of the point of contact of the wheel with the hill, from a vertical line let fall from the axle.

The difference of the obliquity of the line of draught is the chief matter which gives the small wheel the advantage in ascending a hill. ..From all which it must follow, first, that there is an advantage in having the point of draught far forward in ascending a hill. 2d, That having the point of draught as low as possible is also advantageous; as both these circumstances, particularly the latter, will make the line of draught more oblique, and reduce the resistance by shortening the lever by which it acts. 3d, The horse will have more power the farther forward he can advance his centre of gravity, for thus will he be enabled to lengthen the lever; this *gives a farther proof of the necessity of leaving the horse's head free from any curb;* for the extension

of his neck produces this effect in a considerable degree, and assists him proportionally in ascending the hill. 4th, Weight laid on the horse's back will assist him in drawing a load up a hill; for it is by the first mode of mechanical action alone that he ascends hills, wherein this has been proved to increase his power: hence the advantage of one-horse carts in hilly countries is plain, as, when they are used, a part of the loading can always be made to rest on the horse's back conveniently. *It is also evident from the same fact, that the custom of hanging the bodies of gigs and curricles so far back, as is generally practised, is erroneous.*

METHOD OF PAINTING LINEN CLOTH IN OIL COLOURS,

So as to be more pliant, durable, and longer impervious to water than in the usual mode.

From Transact. of London Society of Arts.

THE following process appears to have a considerable improvement and saving of paint, in the manufacture of oil cloth, &c. as adopted by Mr. W. Anderson.

The paint usually laid upon canvass, hardens to such a degree as to crack, and eventually to break the canvass, which renders it unserviceable in a short time; but the canvass painted in the new manner is so superior, that the Navy-board has ordered all canvass used in the navy to be thus prepared; nor is this the only advantage, for a saving of one guinea is made in every one hundred square yards of canvass so painted.

The old mode of painting canvass in the King's yards, was to wet the canvass and prime it with Spanish brown, then to give it a second coat of a chocolate colour, made by mixing Spanish brown and black paint; and lastly to finish it with black.

The new method is to grind 96 lbs. of English ochre with boiled oil, and add 16 lbs. of black paint, which mixture forms an indifferent black. A pound of yellow soap dissolved in six pints of water over the fire, is mixed while hot, with the paint. This composition is then laid upon the canvass (without its be-

ing wetted, as in the usual way,) as stiff as can conveniently be done with the brush, so as to form a smooth surface; the next day, or still better on the second day, a second coat of ochre and black, without any, or but a very small portion of soap is laid on, and allowing this coat an intermediate day for drying, the canvass is then finished with black paint as usual, three days being then allowed for it to dry and harden; it does not stick together when taken down and folded in cloths containing 60 or 70 yards each; and canvass finished entirely with the composition, leaving it to dry one day between each coat, will not stick together if laid in quantities.

From actual trials of near four years, the solution of yellow soap is a preservative to red, yellow, and black paints, when ground in oil and put into casks, as they acquired no improper hardness and dried in a remarkable manner, when laid on with the brush, without the use of the usual drying articles.

Immense quantities of unserviceable ships' hammock-cloths have been destroyed at the King's yards, in order to prevent embezzlement; but means have now been found to obtain the colour laid on them at a small expense, which is effected by burning this unserviceable canvass, taking care to rake aside the ashes and sprinkle them with water, in order to prevent too great a degree of calcination. The ashes are then prepared for grinding by being sifted.

Thus four cwt. of dry colour, valued at 9*l.* 6*s.* has at the expense of 6*s.* been obtained from a ton of canvass. Canvass painted with black paint only, produces a black colour; if painted black upon a yellow or red ground it produces a dark chocolate; if painted lead colour it produces a dark lead.

A great quantity of paint being required at Portsmouth yard, and the allowed number of hands not being sufficient to grind it in the common mills, induced a trial of employing one man to grind with four mills at a time, by placing two mills on each side of the winch. A space of two feet six inches is allowed between the two pair of mills, for the man to stand between them, and the mills of each pair are placed so close as only to

leave room for a fly-wheel to play between them. Fly-wheels at the extremity of the axis are impediments.

It is obvious that this process is a considerable improvement, and it is surprising that the adoption of soap, which is so well known to be miscible with oily substances, or at least the alkali of which it is composed, have not already been brought into use in the composition of oil colours; and we hope this will meet with a due attention, from both the manufacturer and the public at large.

ON FRENCH GREEN.

From the Tradesman.

Almost all greens, if not all of them, have copper for their basis. French Green is made from pearl-ashes and Roman vitriol,* which is a sulphate of copper. Both these articles ought to be got in their utmost purity: a want of attention to this, is the misfortune of the few makers of the colour in this town. This being particularly attended to, I would next recommend one part of pearl-ashes to two of vitriol nearly, or in the proportion of sixteen or seventeen of the former to thirty-two of the latter. The proportion ought, however, to vary, according to the strength of the pearl ash. These ingredients must be first boiled separately and left to settle about 15 minutes; by boiling, the whole of each that is soluble is melted, and by settling, any sediment or grit and dirt falls to the bottom of the vessel: this precaution of letting it settle shows the very great necessity there is for attention in the choice of the ingredients. At the expiration of this time, there ought to be a vessel ready four or five times larger than would contain the two liquors; for when they are poured together, a very considerable effervescence ensues. This being finished, a deposition takes place, and in a little time

* In order to make Roman vitriol, plates of copper are heated red hot in an oven, by which means they become quickly covered with a crust of oxide, which separates as the plates cool; this oxide is then boiled in sulphuric acid, and, when it is dissolved and the solution is become of a proper strength, the whole is poured into leaden vessels to cool and crystallize.

(See 3d edition, Parke's Chem. Cat. page 380.)

the supernatant liquor becomes clear, which is gently drawn off, either by spigots in the side of the vessel, or a crane (a syphon), so as to leave the deposit (which is the colouring matter) undisturbed; this may then be put into bags formed of flannel or linen, three or four fold, to get as much more of the water from it as possible by draining; after which it is put on chalk stones in a circular or square stove to dry, the same as other colours.

I believe, this is nearly, if not exactly the process. What is used to heighten the colour, I am a stranger to; but I suspect whatever is employed in addition to the above, is for that purpose; it might be soon discovered either by a scientific or a practical man.

The dyers of woollen goods obtain a colour which they call French Green from similar ingredients, which are used, I am told, in the following manner:

Two coppers are procured, in one of which, blue stone vitriol (Roman vitriol) is melted with boiling water, and the other contains pearl ashes dissolved in like manner; of the proportions I am not so certain, but believe them nearly as stated for the French Green of the colour-makers: They first put their cloth into the blue stone vat for some time, after that into the ash vat, and so alternately until the degree of colour they require is obtained; the cloth is then washed in pure water, dried and given to the dresser.

The bricklayers and white-washers also use Roman vitriol to procure their French Green in the following manner: According to the shade required, a portion of this salt, dissolved in boiling water, is poured upon a mixture of lime and water. The lime being first finely powdered, this is mixed in a pail, and laid on with a painter's brush; a little melted glue is added to make it bear the air better.

I have the recipe of another colour used by the bricklayers and white-washers, which is at your service. A buff or yellow, is made by the fine of lime, mixed with water, to which a little copperas is added. It is laid on commonly about the thickness of white-wash; glue is added here also, for the same purpose as in the foregoing recipe.

IRON COCKS FOR LARGE RESERVOIRS,

Made by Martin Cawood and Son, Leeds Foundry, Yorkshire, at nearly one half of the expense of common brass ones, and with many very superior advantages of strength and durability.

INSTEAD of casting the cocks entirely of brass, as is customary, the patent cocks are formed of cast iron, and those parts of the piston and cylinder which come in contact, are covered with hard bell metal, which is properly united by the adhesion of tinning and soldering, or brazing, being by these means formed into one compact solid body.

Observations extracted from the Repertory of Arts, for July 1806.

"The common composition for brass cocks, which is made of copper and lead, is found by experience not adapted to bear the extremes of heated steam and a cold and frosty atmosphere. The copper being saturated with a large proportion of lead, its properties are made tender, and easily susceptible of expansion and contraction by heat or cold, which causes the cocks frequently to burst. The lead also makes the metal cloggy, and by a very small heat will strike to the surface; consequently a great deal of friction is produced, which very often so fastens the cock that it cannot be turned, or takes away that smoothness which ought to remain in the piston and cylinder, and then the cock is useless, not being air-tight. Cocks, plated as above specified, are not liable to these objections, as it is universally allowed by all engineers, that good soft iron is found to stand better than any other metal the extremes of heat and cold; hence steam cylinders and hot water pumps for engines are now made wholly of that metal. The metal also with which the piston and cylinder of these cocks are plated, being of small weight, the patentee can afford to make it of such superior quality, that the objections made against common cock-metal cannot apply to his mixture, which is made of bell-metal, wherein no lead is used. Common cocks when out of repair are in general sold as old metal; for when they are ground two or three times, the hole in the piston is so low in the cylinder that it will not admit a sufficient quantity of fluid equal to the bore of the cock; but in these plated cocks, when the piston is worn too low, (which will rarely be the case, owing to the superior quality and hardness of the metal which comes in contact when in use) the piston or cylinder can be plated at a trifling expense, and the cocks rendered as good as new: this in large cocks, for which this invention is more especially adapted, will be a very great saving."